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Smithsonian October/November 1991

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THE AIRPORTS OF YESTERDAY'S TOMORROW

An F-86 pilot remembers Korea

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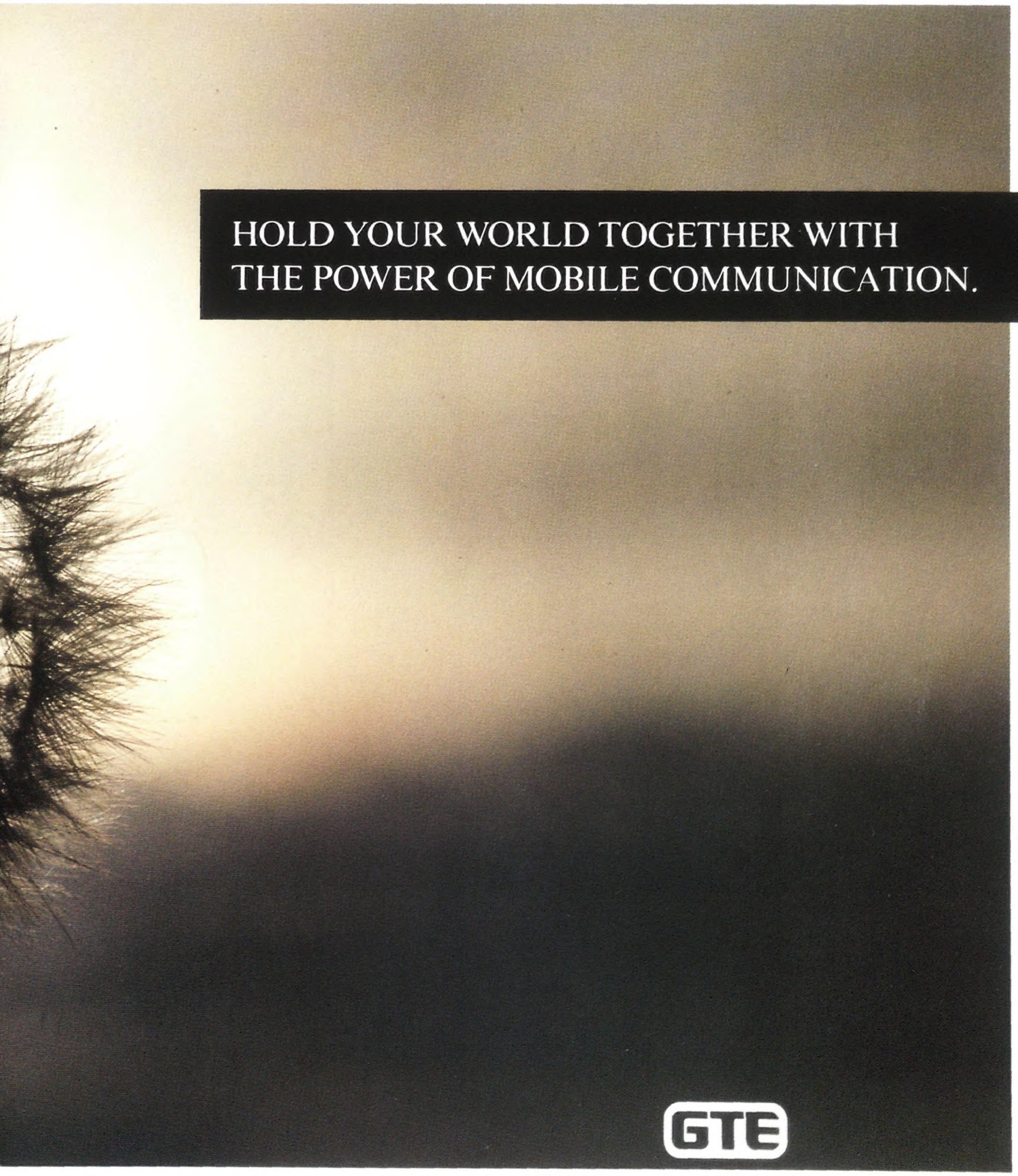

THE POWER IS ON

October/November 1991
Volume 6, Number 4

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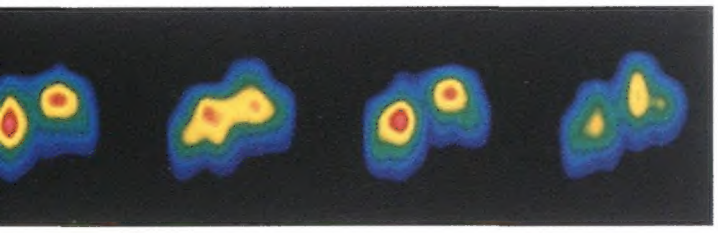
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Cover:
Richard Winslade photographed a pair of Sopwiths, a Camel (top) and a Pup, over their native England.

Departments

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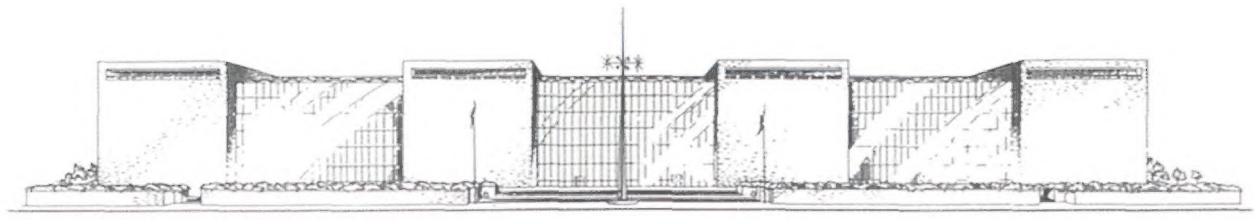

Integrated Transportation Systems

Back in 1930, you could catch a cab from downtown Washington to nearby Hoover Field, fly to Newark in a Ludington Stinson, take a bus into New York, and make that city's center in less than three hours. Today, thanks to faster airplanes, we can still make the trip in under three hours by air and even beat the 1930s pace by a few minutes. But as Ronald E.G. Davies, the National Air and Space Museum's curator of air transportation, explains, our gains in flying time have been all but offset by delays in traffic to the airport, requirements for early check-in and security inspections, the loading of larger numbers of passengers, the queuing of aircraft for takeoff and again for landing, and time spent waiting for luggage delivery at the arrival airport.

Amtrak rail also takes you from downtown Washington to downtown New York in about three hours. No hassle. And a modern, rapid rail system could cut that time to less than two hours.

When I first came to Washington four years ago, I thought it would be nice to have a chance to get away from time to time, to spend a weekend at the home we'd lived in for 25 years, on Lake Cayuga, near Ithaca, New York. Our children had grown up there, and it's a good place to relax.

Ithaca lies 300 miles directly north of Washington. But to fly there by commercial carrier, I need to change airplanes in Pittsburgh. With available connections, I cannot get from downtown Washington to the Ithaca airport in much less than four and a half hours. By car the distance is 360 miles—six and a half hours door to door, rather than airport to airport. And when I arrive I have my own car, so local travel is no problem.

I cite these two examples because they illustrate America's current public transportation dilemma. The United States is a large country with a relatively low population density. Historically, we have not found a way to provide the infrastructure for a dense network of frequently running, high-speed inter-city trains, augmented by good subway, light rail, or bus systems in metropolitan areas, suburbs, smaller towns, and villages. And, for complex reasons, we have come to increasingly rely on automobiles and airplanes, which add to already-severe congestion at large city airports and on major highways.

The transportation problem has been compounded by the ways in which cities have grown in response to low rural real estate prices, the ubiquitous, accessibly priced automobile, and relatively low fuel costs. Downtown, high-rent shopping districts are dying all over the country, replaced by mushrooming beltway malls that can be reached only by car. That makes the automobile even more indispensable, while the rapid spread of cities makes effective subway or light rail nets progressively more expensive.

Flying is a great way to travel when you have to go coast to coast or cross the Atlantic or Pacific. But these long-distance air routes need to be supplemented by a ground transportation network that can reliably and rapidly convey large numbers of passengers over distances of a few hundred miles, with frequent departures throughout the day and quick, inexpensive dispersal from the arrival city center to a final destination across town or in the suburbs.

Just what the new ground travel system might comprise isn't clear. High-speed monorail? Magnetic levitation? Computer controlled, unattended conveyances? Ultimately, infrastructure, relatively inexpensive electric power, and labor costs are likely to be the determining factors. But whatever the system, it should leave air travel restricted to the longest legs of a journey, while providing a way to get around locally once the destination airport is reached.

It's a tough problem, but we have nowhere else to go. The airports, airways, and highways are clogged. Without decisive action the congestion can only increase.

—Martin Harwit is the director of the National Air and Space Museum.

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Letters

Setting the Record Straight

As a performance engineer for the de Havilland aerodynamics department from 1945 to 1960, I was privileged to work closely with many de Havilland test pilots, including John Derry, who became a personal friend. Stephan Wilkinson's statement "We'll never know for sure whether he was literally trying to make a bigger boom..." is nothing more than idle conjecture (Letters, June/July 1991). Derry could not have been aiming the sonic boom at the crowd because the DH-110 was aerodynamically incapable of producing a sonic boom in any mode of flight parallel to the ground; in the initial dive from high altitude, yes, but in level or climbing flight, definitely no.

David R. Blundell
Hendersonville, North Carolina

I could not agree more with Jim Newman's comments on the 1952 crash at Farnborough. I too was there and saw the whole horrifying affair. There is no doubt that John Derry could not possibly have been trying to boom the crowd when the accident occurred.

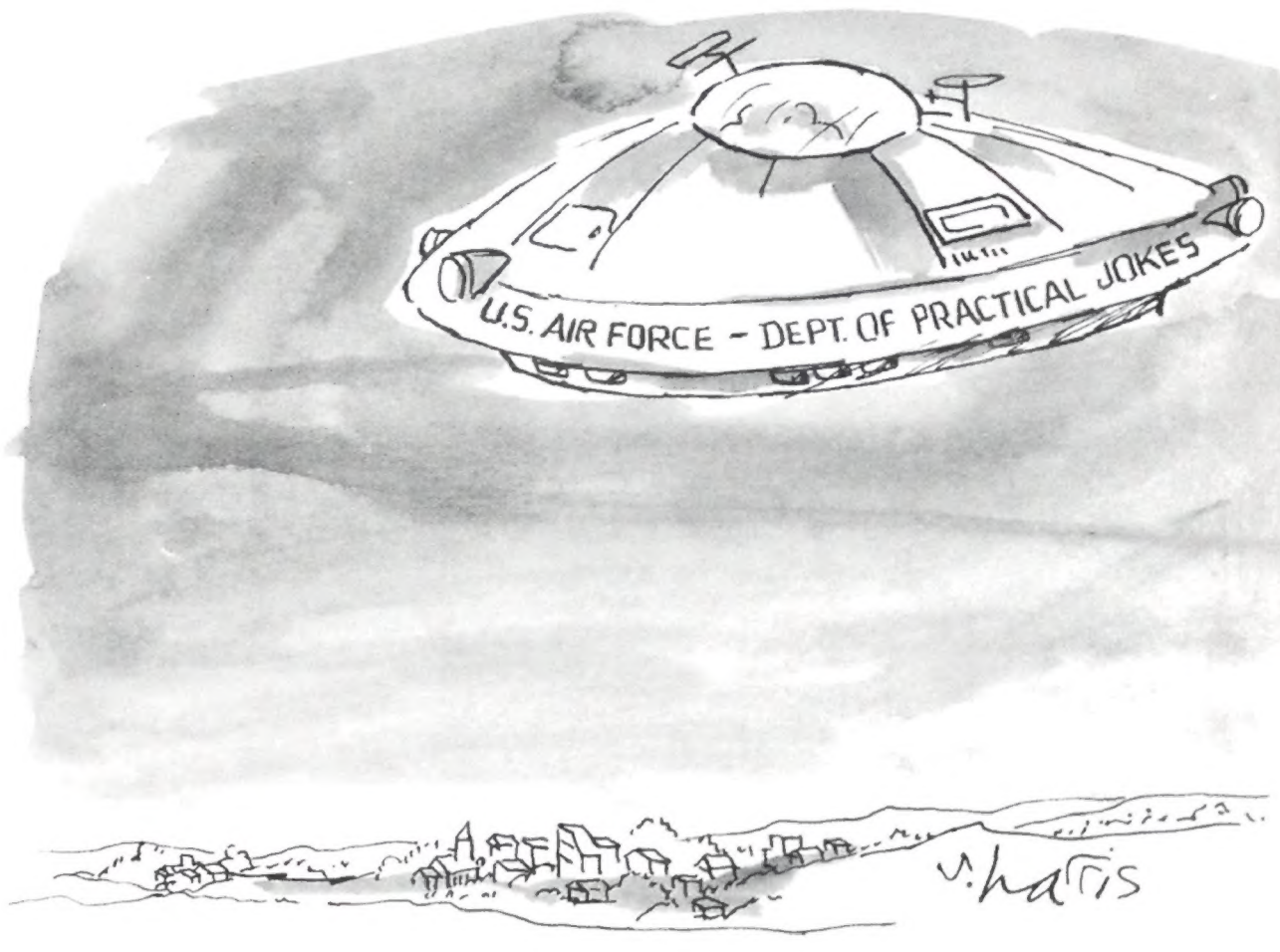
Air Vice Marshal Ron Dick
Royal Air Force (ret.)
Woodbridge, Virginia

I was at Farnborough when the accident happened and I corroborate Jim Newman's account. Stephan Wilkinson should not feel too badly about his inaccuracy; the next day only one British newspaper gave a correct account of the accident.

John Acton
Bucks, United Kingdom

A Strain by Any Other Name

"Doctor's Orders" (August/September 1991) describes the Valsalva maneuver as a technique pilots use to counteract G forces by forcing blood to their heads.



YOUR SEARCH FOR A PERFECT CUP OF COFFEE ENDED IN GÄVLE, SWEDEN MORE THAN 100 YEARS AGO.

Victor Th. Engwall

A great cup of coffee is a revelation. Once you've tasted it, you've experienced one of life's true pleasures. But hard as you search, you can't seem to find that superb taste again—even in gourmet shops.

Fortunately for coffee lovers, a Swede named Victor Theodor Engwall had the same passion for quality. Over a century ago, he started a company in the small seaport of Gävle, and a family obsession was born.

Down through the years, generations of Engwalls roasted, tested and tasted. Even today, they continue their endeavor to blend a coffee that reaches perfection. A coffee that is rich, and full-bodied, without bitterness. One as satisfying in the cup as fine coffee smells at the moment of grinding.

They say that one chilly day King Gustav V sailed into Gävle and tasted it. So impressed was he that he awarded Gevalia the Royal Seal of Approval.

Today, Gevalia is Sweden's most popular coffee. That's quite an achievement since Swedes feel as passionately about coffee as the French do fine wine. They know how crucial each bean is to the delicate balance of flavors. Kenyan AA, Costa Rican, Guatemalan–it takes up to 6 varieties of the rarest *arabica* beans to create the high flavor notes, the delicate nuances, the fine aromatics in Gevalia.

There's yet another secret to Gevalia's flavor: its impeccable freshness. Roasted faster, it's then vacuum sealed to ensure freshness. Because even the finest whole beans rapidly grow stale when exposed to air, as in gourmet shop bins.

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Gevalia Kaffe comes whole bean or ground in a variety of full-bodied roasts. But perhaps the biggest revelation is Gevalia Decaffeinated. Caffeine is removed naturally with the same elements that put the effervescence in sparkling water. The result is a full flavored decaffeinated that is no longer a compromise.

A REGAL BRIBE

As beans of Gevalia's quality are extremely expensive and not available in mass market quantities, the only way to obtain a trial supply of Gevalia Kaffe is directly from our Import Service. Just fill out the attached reply form. We will also send you the gift shown there, free.

Now, at last, your search for a great cup of coffee has ended here in Gävle. The Swedes have known that for years.

GEVALIA KAFFE A SWEDISH OBSESSION

Obviously, you are referring to the MD-1 maneuver, where the pilot tenses his or her lower body and leg muscles while exhaling over a partially closed epiglottis to prevent blood pooling in the legs. The Valsalva is used to equalize ear pressure.

Stephen L. Cheney
Lawrenceville, Georgia

As an F-16 instructor pilot, I must inform you that the "hold-your-breath-and-clench technique pilots use to force blood to their heads" is *not* a Valsalva maneuver. A Valsalva is accomplished by squeezing the nose closed with thumb and index finger, closing the mouth, and blowing gently to pop the ears by equalizing pressure in the inner ear with the air in the cockpit. This maneuver is sometimes necessary after a rapid descent.

The anti-G straining maneuver is called the M-1 or L-1 maneuver. It is accomplished by tightening the upper body muscles, holding the breath, and straining against the G-suit's inflation for three-second intervals. This prevents pooling of blood in the legs, forcing it into the eyes and brain.

Major David Rothenanger
Luke Air Force Base, Arizona

Editors' reply: There are actually two Valsalva maneuvers—one for increasing ear pressure and one for increasing chest pressure. The latter, which entails constricting the vocal cords, is used in anti-G maneuvers, along with muscle tensing.

A Woman's Place Is in the Cockpit

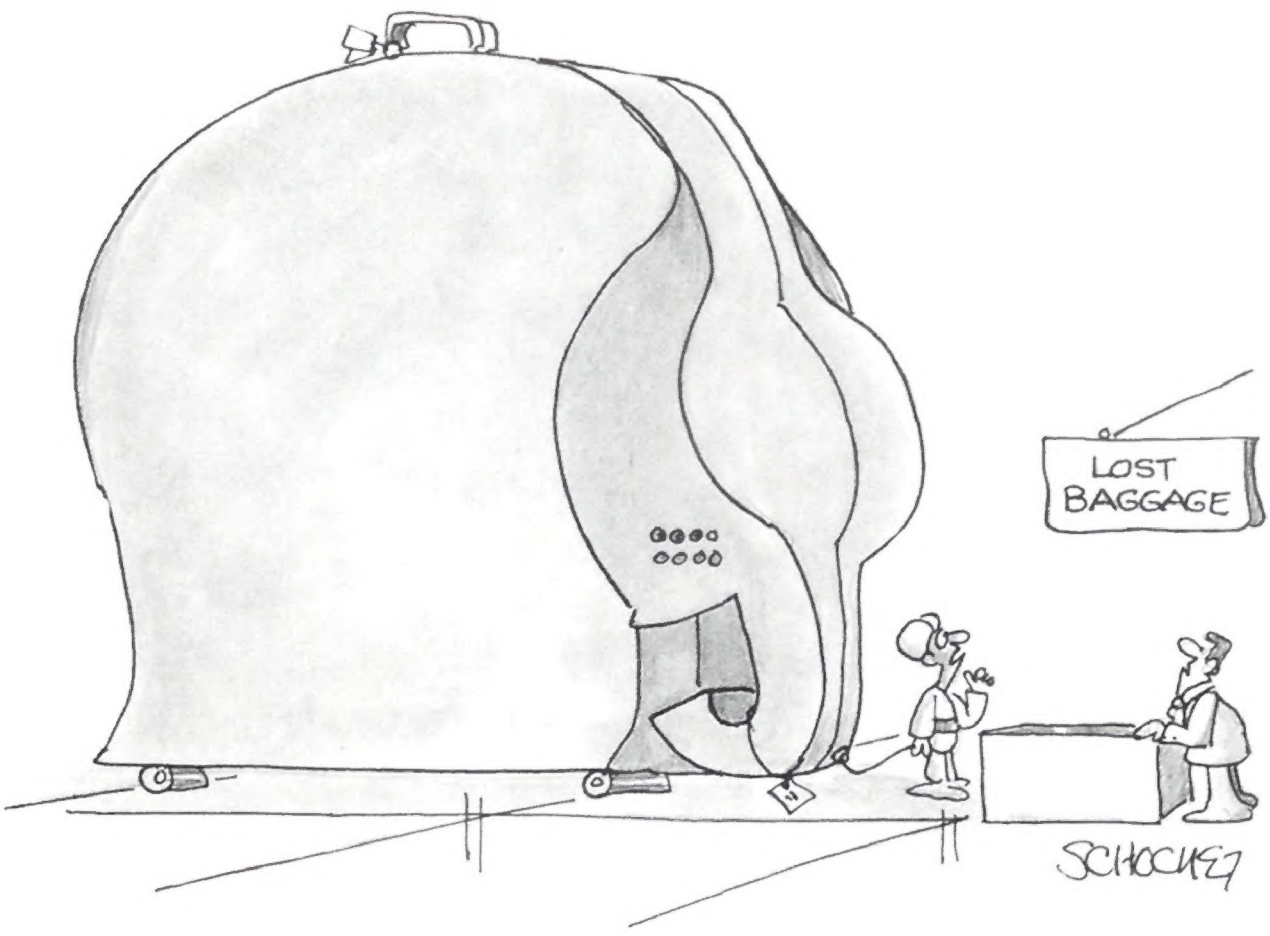
As a female pilot and proud member of the Ninety-Nines, I was appalled and disheartened by Ellis Weiner's "Terminal Fatigue" (Flights & Fancy, August/September 1991). Weiner refers to flight crews as "men toting their glamorously utilitarian flight cases, the women pulling their irritating little collapsible luggage dollies...." The only thing irritating is Weiner's antiquated view of flight crews. He should open his mind as well as his eyes the next time he travels, and he may well find that there is a woman in the cockpit with a glamorously utilitarian flight case.

Abbé J. Janov
Needham, Massachusetts

Cutting Remarks

A report on the Israeli Air Force Museum (Collections, August/September 1991) mentions a P-51 "used to sever Egyptian telephone lines with its propeller in the opening hours of the 1956 war." Any crop duster pilot will tell you that it's not good when telephone lines reach out and touch you. Actually, the P-51s were flown at low level, trailing weighted steel cables designed to snag and cut through the telephone wires. This technique made the flights last longer.

Lieutenant Colonel Allen J. Parmet
Brooks Air Force Base, Texas



"It's the mate to this one."

Diamonds Are an Angel's Best Friend

"Jimmie Angel, Devil's Mountain, and the Lost River of Gold" (June/July 1991) brought to mind my only encounter with the adventurous pilot. In 1950 I was a junior first officer with Pan Am. En route from Miami to Panama, the captain told me of his investment in a diamond venture with Jimmie. It seems Angel had located a source of diamonds in a stream somewhere in Venezuela and needed money for development. This captain, along with others, had provided capital, but he was most unhappy with the project. There had been no diamonds and no progress report from Jimmie. In fact, the captain couldn't wait to get his hands on Angel to demand his money back. As luck would have it, Angel happened to be at the hotel in Panama. He came up to our room and showed us a vial about half-full of small stones. They could very well have been diamonds; the man could certainly make a persuasive sales pitch. Before Angel left the room, the captain had his checkbook out and was pressing more money on him.

I.J. Moore
El Cajon, California

Beetles on Mars

After reading your article on the Mars rover ("Getting Around on Mars," June/July 1991), I came up with a suggestion. A modified VW Beetle might just be what we're looking for. The Bug certainly has a record of reliability, and with a set of snow tires, any terrain from the polar icecaps to the Great Mariner Valley should be no problem. Another advantage is the Beetle's low launch weight, but best of all is the low price. A used Bug, even with extra-planetary options, will be a lot cheaper than any of the other rover designs.

John Hanley
Norwalk, Connecticut

Let There Be Stretch

I enjoyed reading about Margaret Geller's excellent work in "Surveyor of the Universe" (August/September 1991). I was especially intrigued by the use of the verb "stretch" in describing the universe. We hear of "12,000 galaxies stretching 500 million light years across space" and that "the tremendous velocity of the universe's expansion stretches out the light from fleeing galaxies and makes it appear redder." Could it be a coincidence

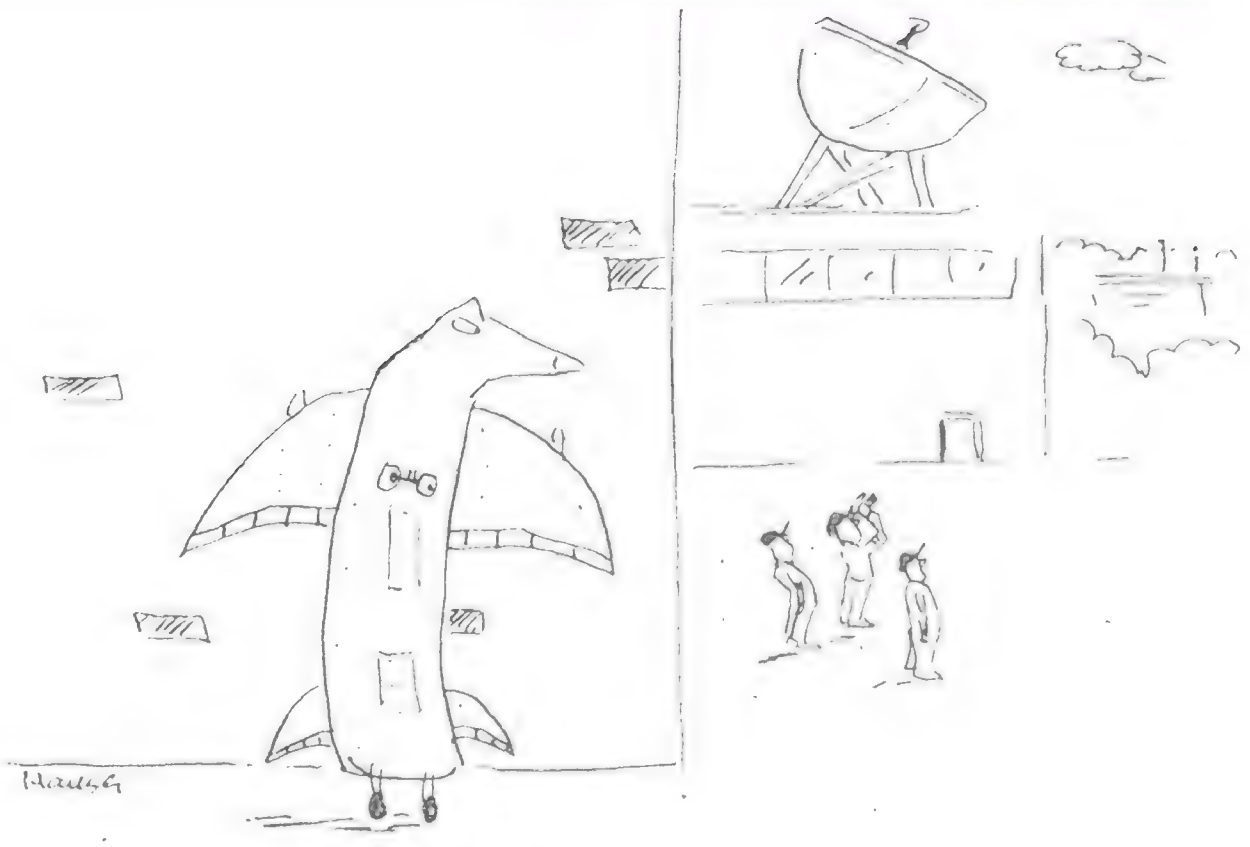
that the prophet Isaiah said, "Thus saith God the Lord, he that created the heavens, and stretched them out..."?

Trond Woxen
North Hollywood, California

But Is It Safe?

I found "Offbeat Landings" (June/July 1991) a fine documentation of the many eccentric setups of surplus aircraft one can find in our cultural mosaic of a country. No doubt such weird, fad-like proclivities are typical of the adverse psychosocial dispositions so commonly found in the pop culture movement. But do people who get carried away with mounting airplanes in odd ways seriously consider the safety factors involved?

Anthony P. Wawrzynek
Phoenix, Arizona



The EXTRA stealth bomber

Corrections

Due to an editing error, the YF-12A was described as the "earlier, single-seat version of the SR-71" (Above & Beyond, August/September 1991). The YF-12A was a two-seater; it was the A-12 that flew as a single-seater.

A caption in "Forecast: Liquid Helium Showers, Temperatures 290 Below Zero" (August/September 1991) misidentified a radio telescope as a radar telescope.

The Vacuum Fallacy

"The Legacy of the Lifting Body" by Stephan Wilkinson (April/May 1991) states that around 1960 the first lifting body had "a shape like a badminton shuttlecock sliced in half lengthwise, the resulting flat side up...." But just three pages later, the article says: "Lifting bodies make lift the same way an ordinary airfoil does: a low-pressure area is created above the vehicle because the air flowing over it must move faster to reach the trailing edge at the same time that the underflowing air does." There is an obvious contradiction in these sentences: the top of the lifting body is flat and the bottom is round. No matter what the angle of attack, the underflowing air has more distance to travel.

The "reduced pressure" explanation of lift is frequently cited in museum displays, aviation publications, and flight instruction books, not to mention flight training videos. That is: since the air has to travel a longer distance on the curved top of the wing than on the bottom, it has to move faster on top, and according to the Bernoulli principle, this creates a lower pressure on top of the wing. This area of low pressure creates lift. But how does this concept fit with the following facts?

1) You can make a flat piece of plywood fly by fitting it with elevons, a rudder, and an engine. With a radio control it flies very well and can do aerobatics. (I have an eight-millimeter film to prove it.)

2) Aerobatic aircraft frequently have symmetrical airfoils (wing surfaces with the same curvature on top and bottom).

3) An airplane with the conventional wing profile (curved on top) can maintain inverted flight.

The reality is that the partial vacuum at the top of the wing is incidental to lift. What causes the lift is a less esoteric, more down-to-earth and common phenomenon. It is the same action that makes it difficult to hold a high-pressure fire hose, gives lift to your hand outside of a moving car, and makes a propeller pull an airplane or push a boat. Jet engines and rockets also make use of the phenomenon through the reaction of gases, accelerated by a combustion process. (It is interesting to note that although the function of an airplane propeller is always compared with that of a wing, I have never read that an airplane is pulled forward by the vacuum in front of the propeller.)

What creates lift is simply the reaction applied to the wing by the mass of air accelerated downward by the wing in flight. Newton observed that every action has an equal and opposite reaction, so as the wing forces the air down, the wing, in turn, is forced up. The degree to which the wing reacts is a function of the quantity of air deflected and of the acceleration given to this mass of air. Reaction is a force and so is weight, and they are measured with the same units: pounds or newtons. The reaction force is called "thrust" in the case of rockets, jet engines, or propellers. It is called "lift" in the case of wings. At all times in horizontal flight, the force directed upward, which is due to the mass of air accelerated downward by the wing, must equal the weight of the airplane. The reaction must be larger to climb and smaller to descend.

Why are the shape and curvature of the wing so important?

Because a wing must have a certain thickness for structural strength and to accommodate the mechanisms controlling the ailerons, flaps, landing gear, and fuel tanks. And for each different utilization, from glider to jet airliner, from cruise speed to landing speed to stall speed, there exists a compromise for the best size, shape, and profile to give a wing. Things become very complicated then, and so ends my science.

But I am certain that if my little airplane relied solely on vacuum to get lift, it would not take me up in the air.

Jacques Meslin
Ferndale, Washington

Concerning the matter of pressure distribution on airfoils and wings, or any lifting body, it is well known that a pressure distribution is created simultaneously with the deflection of the airstream. Local pressures at points anywhere on the body may be greater or less than ambient pressure. Lift, in the broadest sense, can be understood on the basis of the deflection of air downward. But when air is deflected, a field of varying pressures is also created. When a wing or lifting body experiences positive lift, the average pressure on the upper surface usually will be less than that on the lower surface. Indeed, the upper surface suction may contribute more to the total lift than the higher pressures on the lower surface, but the difference in pressure is still the result of the deflection of air. It is not even necessary to have suction on an upper surface in order to generate positive lift; it just happens that upper surface suction does exist on most conventional, lifting wings. But that is not a requirement: a stalled wing may still produce lift. The point is that the deflection of air—whether up, down, or sideways—caused by the shape, attitude, and relative motion of a body is the primary requirement for generating forces. Isaac Newton explained that long before Daniel Bernoulli and Leonhard Euler presented us with their equations.

J.L. Potter
Department of Mechanical Engineering, Vanderbilt University
Nashville, Tennessee

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Lighter Than Air, Loaded for Bear

If Westinghouse has its way, blimps are going to do a lot more than hawk film and hang around football games. Though known to most people as an appliance manufacturer, Westinghouse has launched a prototype surveillance blimp half the size of one it hopes to build for the Department of Defense.

The full-scale Sentinel 5000 will be a kind of Terminator version of a blimp. The flight control surfaces run on fiber optics. It has a sidestick controller, like the F-16, and a three-axis autopilot. Its Porsche engines and ducted propellers can swivel to direct their thrust, which makes it a short-takeoff-and-landing blimp. Its envelope is transparent to radar, technically making it "stealthy," though it has none of the kinky appeal of the F-117. And in addition to exotic radar and electronic countermeasure gear, it can tote air-to-air missiles and torpedoes.

Westinghouse knows it won't be easy to create an image of a blimp as a fighting machine. Maybe that's why its ads carry the headline "No, We're Not Kidding." So one muggy day last July, the company invited reporters to its blimp plant in Weeksville, North Carolina, for a demonstration of the smaller Sentinel 1000, which is being marketed as a border patroller, fish and fire spotter, pollution monitor, search-and-rescue vehicle, and communications relay.

The company found itself in the airship business when its British partner, Airship Industries, went under last fall and Westinghouse took over the company's Weeksville facility, just northwest of the Outer Banks on Albemarle Sound. Two huge hangars loom amid the lush green fields and weed-cracked concrete that served as a military airship base in the 1940s. One now houses a furniture factory; in the other, a buoyant blimp envelope was ensnared in a net and anchored with sacks of sand like the catch of the day.

After presentations on the past and future state of Westinghouse airships and a video of the Sentinel's first flight in June—a dress rehearsal for today's demo—the speakers herded everyone outside, where jackets were shed and ties loosened. Over by the furniture hangar, two pilots were running up the Sentinel's engines. Up close, blimps at full power sound like a race car track on a Saturday night.

After a takeoff run of several feet with engines howling, the pristine white prototype was off, thanks to vectored thrust, and climbed out at a fantastic angle. When asked how the neighbors feel about blimps criss-crossing their town, vice president of business development Jud Brandreth replied, "They're all airship experts around here by now. Blimps seem to give people the warm fuzzies."

The Sentinel 1000 leveled off at a few hundred feet, chugged in lazy circles over the sound, and drifted back down near the furniture hangar, where the ground crew, in blue shorts and jerseys, snagged its mooring lines and settled it to earth like a precisely choreographed chorus line.

The demo was low-key: the Sentinel had already made three test flights and was not yet capable of disrupting enemy radar or launching dummy torpedoes. But its potential as a sophisticated low-cost, low-maintenance, long-duration observation platform goes a long way toward overcoming what Brandreth calls "the giggle factor."

The artists' depictions in the promotional glossies show Sentinels bristling with antennas busily surveying, communicating, patrolling, and blockading while emitting purposeful streams of beams and arrows. For now, however, the plump white airship looks more at home wafting aimlessly over the North Carolina cornfields.

—Patricia Trenner

LEE BATTAGLIA

A-7s Deep-Sixed

Navy pilots aboard the USS *Kennedy* returned from the Gulf war to hugs, cheers, and parades, but their airplanes

were greeted by mothballs. On May 23 the Navy retired its last two squadrons of A-7E Corsair IIs, a bomber that has been operating from U.S. carriers since the Vietnam war.

The A-7Es were the last active-duty aircraft built by LTV Corporation's aerospace and defense division, and the decommissioning left a hollow feeling at the company's sprawling West Dallas manufacturing complex. For the first time since 1922, Navy carriers will steam out without aircraft built by LTV or its predecessor, Chance Vought. Pictures of the Corsair II still line the office of former program manager Steve Yarbrough, who says it may be a while before he gets around to taking them down.

As the A-7's retirement was triggering nostalgia for the company's past, many employees were also pondering its future. Only three days before the A-7 was decommissioned, LTV announced plans to sell the aerospace and defense unit to feed creditors and hasten the end of its five-year bankruptcy ordeal.

The division, particularly the Aircraft Products Group, is largely a descendant of Chance Vought Aircraft, which under that name and later as the "V" in LTV, built more than 15,000 aircraft for the military, ranging from the VE-7 Bluebird trainer in 1917 to wing sections for the B-2 stealth bomber today.

The venerable company was founded by Chance Milton Vought, an engineer and pilot who learned to fly six years before cutting his first aircraft deal with the military. "Nobody could forget Chance Vought," wrote his business partner Frederich Rentschler in an early 1950s magazine essay. "Almost immaculate in dress, always inquiring and restless for facts and fineness, and above all, completely consumed and absorbed by aviation. In addition, he had a reputation for rough sailor language that seemed completely out of line with his dandy appearance."

Vought never got to see the stellar performance of his company's airplanes during World War II. He died of septicemia in 1930, at age 40. But the company he founded on the third floor of a women's hosiery factory in Astoria, New York, continued to thrive. When Vought Aircraft moved to Dallas in 1948, it was the largest corporate relocation in history.

As the last LTV aircraft were pulled from active duty last spring, some 10,000 employees swapped stories about who might buy their ailing division. Rumor has it that Boeing, once a sister company when both were owned by United Aircraft, is a leading candidate. Boeing, the only existing aircraft maker older than Vought, is keeping mum.

—Loren C. Steffy

Update

Memorial Closed

"Space Mirror," the new Kennedy Space Center memorial to astronauts who died in the line of duty (Soundings, June/July 1991), was declared a safety hazard and closed last August. After it began audibly cracking and popping, an investigation revealed that two pieces of hardware that tilt the huge granite slab were inches out of alignment. The memorial will not reopen until its designers correct the faults.

EILEEN SAMELSON (2)

The Good News Is the Rocket Worked

A rocket-borne probe shed no light on the sun's darkest secret, but its launch from a banana plantation in Mexico last July nonetheless made Florida the first U.S. state to sponsor a space mission.

Launched atop the Spaceport Florida Authority's first rocket, a handcrafted three-pound photometer was supposed to radio back data on the solar corona from an altitude of 55 miles during the longest total eclipse since 1973. Scientists from the Florida Institute of Technology choked back tears when their photometer failed to work. Officials of Florida's commercial space agency, however, were quietly euphoric. Even though the $100,000 mission fizzled, the 12-foot Viper 3A supplied by Orbital Sciences had flown flawlessly.

"We can expect some startup problems in all complex programs," said agency executive director Ed O'Connor. "We see no long-term effect [on space commerce] even if the data is not recoverable," he added as researchers scoured their computers for any blips that might have been recorded.

El Eclipse del Siglo, the eclipse of the century, had been the chance of a century for FIT astrophysicist Nebil Misconi and his students. It took them only 12 weeks to plan the mission, fashion an instrument, and prepare the launch site. With the help of Spaceport Florida and the Mexican government, they built a concrete pad on donated farmland in a Pacific Coast village. Santiago Ixcuintla was one of the sites where the sun's corona would glow the longest.

At high noon on July 11, the only light above the dusty stone streets was an eerie ring of fire. Superstitious mothers-to-be hid in their homes, afraid the premature darkness would harm their unborn. Some 5,000 tourists, amateur astronomers, and villagers gathered to view the eclipse and the first rocket launch from Mexico. A popsicle vending cart toyed with the attention of sweaty, rifle-toting soldiers who formed an olive-drab force field around the launch site.

The Viper zipped from its launching rail like a bolt of lightning in reverse, alarming cows in an adjacent pasture. After a few minutes it was clear that the launch had amounted to little more than fireworks, but, said O'Connor, "the basic concept of the operation had been proven"—space science experiments can be quick and easy work when flown on commercial suborbital rockets instead of huge boosters or NASA's shuttle.

Spaceport Florida was established in 1989 to promote space business in the state. Soon after, the agency selected as its inaugural flight the launch of a weather research instrument aboard a Viper from an Air Force site in Florida's panhandle. But an environmental review delayed that plan last May. The red tape that set the state's first launch in a foreign country was an embarrassment, but O'Connor said at the time that the quality of the science available from the eclipse overrode the agency's desire to fly its first rocket from home.

—Beth Dickey

Great Expectations

When the moon's shadow swept across the island of Hawaii on July 11, the dormant volcano Mauna Kea was the place to be, and you didn't have to be an astronomer to figure that out. By dawn the usually near-deserted summit, 13,800 feet above sea level, was swarming with VIP eclipse chasers, journalists, college students, and administrators at the Mauna Kea Observatory. A video artist stood with camcorder at the ready. Sony chairman Akio Morita was scouting for the perfect view. The island's mayor came in by helicopter, as did the governor. The chief of police and the head of the Hawaii National Guard turned out. A Japanese ecliptophile who spent two weeks trekking up from sea level by bicycle had pitched a tent. At 6:31 a.m. they all stood looking east, armed with telephoto lenses and Mylar to peer through, ready to catch the sun's disappearing act.

The only eclipse chasers not in view were the ones to whom it mattered most, the astronomers here to take advantage of a once-in-a-lifetime opportunity—the first eclipse to darken the skies over a major observatory. Most had been preparing for two years, long enough to drive their colleagues to distraction. ("The guy in the next office doesn't even want to *hear* the E-word," said one.)

A mere four minutes and 12 seconds of darkness had lured them all here. When the last bit of the sun disappeared behind the moon and the pearly white corona blossomed, the crowd was reduced to awed murmurs while observatory director Don Hall narrated for ABC's "Prime Time

Live." Even some astronomers, who had been sequestered with their monster telescopes and electronic cameras, left the instruments on automatic and scurried out to take a peek. But they never took their minds off their experiments. "It's like taking a picture of the pope at the Taj Mahal," said an astonomer. "You only get one shot at it."

—Andrew Chaikin

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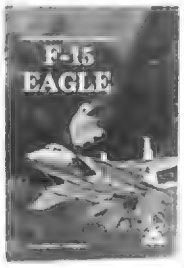

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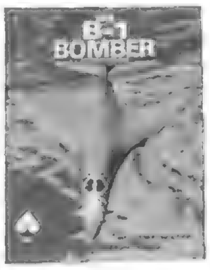

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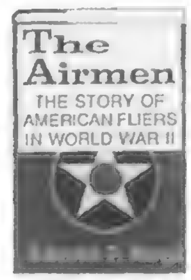

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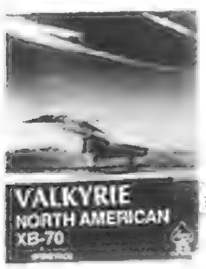

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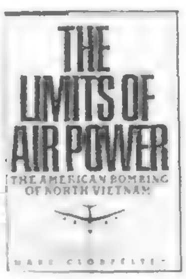

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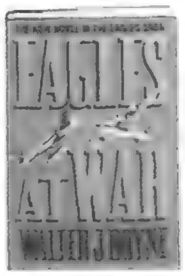

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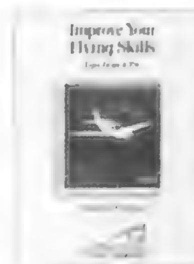

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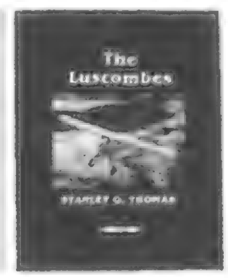

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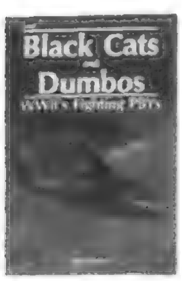

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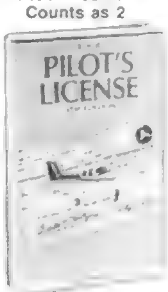

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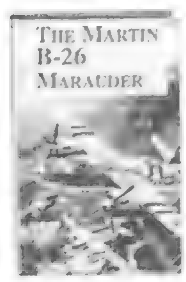

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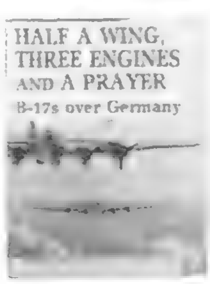

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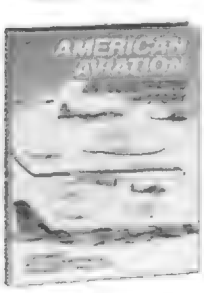

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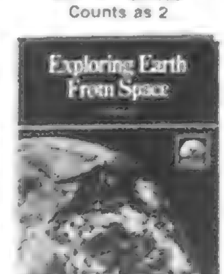

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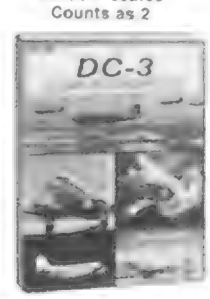

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appropriately. One, trying to look like an airplane mechanic, carried a small red toolbox and wore hightops, white bobby sox, cutoffs, a white blouse, and a blue cap. And a couple of girls donned military flightsuits, unbuttoned to the waist, and struck busty poses. "Try and get my face in the picture this time," one told a photographer.

The models and photographers were for the most part amateurs striving to help each other improve their techniques and build their portfolios. Christy Sherrer, a student at San Jose State who models part time, admitted, "I don't know a lot about planes. But when I show people the pictures, they go 'Wow!' So that's kind of neat."

Of course, the girls wearing the least had the greatest number of cameras aimed in their direction; nonetheless, Ketler is convinced that the airplanes were a big part of the attraction. He has scheduled another shoot at Oakdale Airport near San Francisco Bay with members of the Confederate Air Force. But the only person at Hayward who seemed to be paying much attention to the aircraft was Alan Holloway, owner of the Stearman. While the photographers focused on a woman in a black garter belt sitting on the edge of the cockpit, he focused on her bright red four-inch heels as they idly drummed against the fuselage. "It kind of scares me," he said. "I've got to keep an eye on what they're leaning on. It's an all-fabric airplane and it's kind of fragile."

—Elaine de Man

JORDAN CONRAD

Careful With Those Spike Heels, Please

Anyone at Hayward Air Terminal, east of San Francisco, one Sunday last June might have wondered why a bikini-clad woman, feather boa trailing in the wind, was standing in the cockpit of a silver 1943 Stearman. On closer inspection, however, you could see a pack of photographers circling the biplane while another group focused on a bright red 1941 Stearman as a woman in Spandex caressed its propeller.

The occasion was billed as a Glamour Photo Day, which sponsor Warren Ketler of Thru The Lens holds every month to give photographers an opportunity to hone their skills at $50 for four hours. Ketler uses motorcycles, trucks, aircraft, and antique cars as props for models wearing next to nothing.

In addition to the two biplanes at Hayward, Ketler had provided a Sabreliner and a Cessna O-2. The theme for the day was "Fun in the Sun," but a typical Bay Area fog kept the temperature at a cool 60 degrees. Ketler couldn't do much about the weather, but he did provide swimsuits (barely enough fabric to wipe a dipstick), lingerie, and the "bit of peek-a-boo" he promised in his brochure. The photographers, who were warmly dressed, didn't seem to mind that the models were shivering.

A few models made an attempt to dress

National Airport's Many Happy Returns

Backed by a small orchestra, the lounge singer in the ivory dinner jacket worked his way through a love song: "We're lost inside this lonely game that we play." Later, he crooned "Come Fly With Me" to an audience of a few hundred. The acoustics made it sound like the band was playing in a hangar. It was: at Butler's general aviation hangar at National Airport in Washington, D.C., in honor of the airport's 50th birthday last June.

The celebration transformed the Butler hangar into something like the site of a company picnic. Families strolled beneath serpent-like balloons that swagged down from the arched ceiling. Airline company booths lined the wall, but interest was tepid—with the temperature a scorching 98, it was simply too hot. Airport officials hovered around a birthday cake as the USAir Jazz Orchestra played a snappy rendition of "Happy Birthday." Box lunches of hot dogs, potato chips, and colas were big sellers at what vendors billed as the 1941 price of $1.

Some people wandered from the hangar onto the parking ramp, which turned gummy under the fierce sun. On display was a yellow fire truck, a restored Stearman, DC-3s from Piedmont and Continental, a tiny Piper Cherokee, and a Trump Shuttle Boeing 727, the only vehicle that attracted a line. The Piedmont DC-3's open door beckoned invitingly, but

a sign warned the curious not to enter. Yellow security tape kept visitors from drifting onto the taxiways.

North of the Butler hangar sits National's grand old terminal. The dark floors, metal railings, and gray ceilings give the interior a dated feel, but the view of the main runway, which parallels the Potomac River, is still spectacular. The airport's location inspires either love or hate. Washingtonians appreciate the convenience of the downtown site, but nearby residents despise the noise, and parking is scarce.

After 50 years and 400 million passengers, National needs a facelift, and it's getting one. Plans call for improved roads, parking garages, moving sidewalks, a new control tower, and a 35-gate terminal to be situated a mere 110 feet from the subway. (It's a good 10-minute walk to the present terminal.) If all goes well, by 1997 National should be equipped to endure the demands of the 21st century. Perhaps in 2041 someone will sing "Come Fly With Me" in honor of the airport's 100th birthday.

—Diane Tedeschi

DAVID CLARK

Space Station Fare: Spud Lite

Sweet potatoes will be as basic as lettuce and wheat in an astronaut's diet, according to Walter Hill, dean and director of research at Tuskegee University's School of Agriculture and Home Economics in Alabama. Hill and his Tuskegee green thumbs, who have been growing sweet potatoes for NASA since

1986, are banking on the crop's becoming a staple aboard a space station or on the moon. "Coupled with other crops, they have the potential to provide a full array of nutrients," says Hill. The edible root contains protein, carbohydrates, and vitamins A and C. But, Hill adds, "There's a psychological factor that's really important: the diet also musn't be boring."

Chefs from Taiwan and Japan took their native vegetable and spices to a sweet potato technology symposium at Tuskegee last June to show farmers and scientists from four continents a thing or two about menu variety. Sponsored by Walt Disney World's Epcot Center, NASA, and the Department of Agriculture, among others, presentations ranged from "Regulation of Expression of Gene Coding for Sporamin and ß-amylase of the Sweet Potato" to "Sweet Potato Product Innovations by Small Businesses." Tuskegee's goal is to develop a variety that produces lots of spuds in a little space. "They're fast growing and they do very well in a soil-less culture," Hill says. "In a closed environment their yields are over twice what a good farmer would get per plant."

About 180 attendees sampled such dishes as sweet potato noodles, stews, salads, milkshakes, gelatin desserts, and sweet-potato-and-fish-burgers sauteed in oil, dipped in barbecue sauce, and served on whole wheat buns. Commenting on the variety, Hill said: "That's the imagination that's going to be required in space." For those on the receiving end, make that imagination and an adventurous palate.

—Beth Dickey

Update

By the Numbers

The International Aerobatic Championships held in Fond du Lac, Wisconsin, last August introduced a new twist in scoring ("Ballet Among the Clouds," August/September 1991). Participants in the Aerobatic Masters Contest were graded immediately upon completion of their sequence, which consisted of six unknown maneuvers. Unlike traditional aerobatic scoring, which takes hours of deliberation and computing, judges simply held up numbered cards like those used in Olympic competitions.

Update

G Whiz

McDonnell Aircraft Company is testing a water-filled G suit that may allow fighter pilots to withstand up to 10 Gs ("High Gs, High Risk," October/November 1987). The 25-pound suit encases the torso from neck to toes. In centrifuge tests last summer, two pilots wearing Atlantis Warrior suits withstood 10 Gs for 10 seconds followed by 8 Gs for three minutes with minimum straining and no loss of vision.

A Touchy Situation

You'd think that with all the stars from Desert Storm lining the runways at the Paris Air Show last June, fear of terrorism would have prompted extra-tight security. Not so. "The threat was no greater than any other year," said Jean Garat, the show's organizer. The gendarmes and surveillance teams that kept 24-hour watch over the aircraft and displays at Le Bourget airport set up nothing out of the ordinary, even for the visit of French president François Mitterrand.

In fact, Mitterrand, on his initial tour, had to share the place with tourists. The president had made a last-minute change in his arrival time, appearing late in the afternoon instead of at 9 a.m., so airport officials let the press in early and allowed them to stay. "Just keep out of the way of the cortège," they were told. Mitterrand and his ministers mingled with onlookers in the aisle, elbowing their way through exhibits (or letting their bodyguards do it for them).

The casual atmosphere evaporated, though, when Mitterrand slipped out to examine this year's show stopper, the F-117A stealth fighter. Here, security—U.S., not Le Bourget—nearly caused an international incident, or at least an insult. The jet was ringed by three security teams consisting of Marines and Air Force veterans of the Gulf war. French defense minister Pierre Joxe must have assumed that the unbuttoned ambiance inside extended to America's top-secret fighter-bomber. While the president was admiring the aircraft, Joxe approached the F-117 and reached up to touch the wing. Before you could say "*sacrebleu!*" Lieutenant Colonel Ralph Getchell slipped

in between his aircraft and Joxe and politely but firmly told the minister hands off. Joxe's arm came down; he humbly returned to his place. People in the crowd looked at one another. The TV cameras got it all.

The sequence was played and replayed—in slow motion and with amused commentary—on all the French evening news shows. Air Force officials refused to discuss the matter, saying only that security was still a major concern for the F-117. "What it feels like, what equipment is hung on it, all these are still highly sensitive areas," said one Air Force spokesman. Lockheed, the aircraft's builder, agreed. "Those fliers were told by [defense secretary] Dick Cheney, 'Nobody touches the aircraft,' " observed one Lockheed official.

But by the end of the airshow, F-117 security had come down a notch. Getchell gave a talk about his adventures over Baghdad on the first night of the war. And after repeated requests from airshow participants, Cheney approved two five-minute flyovers. But just to be on the safe side, the aircraft was flown from Ramstein Air Force Base in Germany. Nobody at Le Bourget saw it take off or land. "It was more a photo op than an aerial demonstration," said an Air Force spokesman.

The question remains: Why did Joxe get so affectionate with the F-117? The defense minister is a lawyer and former interior minister, not an engineer. What could he have learned by caressing the wing of the world's first operational stealth fighter? Maybe the truth is simpler. As someone in his entourage said, "I think he just likes airplanes."

—Joshua Jampol

Update

Hello? Hello?

Orbcomm X, the tiny communications satellite built by Orbital Sciences for Virginia's Center for Innovative Technology (Soundings, June/July 1991) and launched on an Ariane rocket last July, is not communicating. After a successful launch, Orbital Sciences had contact with Orbcomm X for several hours, but once its transmitter was turned off during a routine test Orbital was unable to reestablish contact.

Above the Trenches

Between 1914 and 1918 the western front barely moved as a generation of men lived and died in the zigzag trenches of Europe. In *The Great War and Modern Memory,* Paul Fussell writes that this underground world made it theoretically possible to walk from Belgium to Switzerland and never leave the trenches.

An exhibit in which trench warfare is a constant presence may seem out of place at the National Air and Space Museum, but visitors to "Legend, Memory, and the Great War in the Air" will see World War I from the points of view of both the pilots and the soldiers in the trenches. The gallery, scheduled to open in November, reexamines the role of airplanes in World War I and contrasts its romantic legacy with the grim reality on the ground.

"Basically, what we're trying to do is show people that their historical sense is formed through impressions and through popular culture in some respects," says curator Dom Pisano. One of the greatest image makers was Hollywood, and the gallery's mockup of a 1930s movie theater gives visitors the chance to watch clips from *Wings* and other productions that portrayed pilots as knights in the air, flying high above the mud, barbed wire, and carnage in the trenches.

Suspended above the marquee is one of the movie stars: the same Pfalz D.XII that appeared in *Dawn Patrol* and *Hell's Angels.* The gaudy airplane seems to belong to a different world than that of the nearby Voisin VIII. One of the oldest bombers in existence, the Voisin is also the largest airplane in the display. With its wings stretching nearly the width of the gallery, the Voisin effectively exemplifies the fact, often overlooked in popular entertainment, that bombers as well as fighters played a role in the Great War.

Rapid advances in aircraft design made the Voisin obsolete early in the war. Near it is an Albatros D.Va, one of two remaining in the world and another example of an airplane that was obsolete before war's end. Its successor, the Fokker D.VII, was considered the German's best fighter, but it arrived too late to change the war's outcome.

The gallery includes both a Fokker D.VII and one of its leading adversaries, a Spad XIII. The Spad's pilot, U.S. ace Ray Brooks, is also featured in one of the gallery's videos. Made just before Brooks' death last summer at the age of 95, the video examines the role that aces played in the war. Despite the enduring stature of Eddie Rickenbacker, Manfred von Richthofen, Billy Bishop, and others, their contributions in fact had little effect on the war's outcome. Most important was their role in tactical development and morale-raising propaganda.

Another latecomer to the war, the Sopwith 7F.1 Snipe, is also included in the gallery. Though it saw little action, the Snipe became the standard fighter for the newly created Royal Air Force, which had been formed by combining the flying corps of England's army and navy.

One of the final exhibits ventures back underground, this time to a mockup of a London subway stop being used as an air raid shelter. It's a reminder that bombs were falling on Londoners as early as 1915. The gallery concludes with *The Long Shadow,* a video about strategic bombing in the decades following the Great War. The impressionistic film shows how the shadow of strategic

When it's completed, the Museum's World War I gallery will contrast legend and reality.

CAROLYN RUSSO

THE PLANE THAT CONQUERED THE SKIES.

Precision-engineered model of Shoo Shoo Baby is shown smaller than actual size of 9⅜" (23.81cm) in length. Wingspan of 12⅞" (32.70 cm). Scale 1:96.

SHOO SHOO BABY

B-17G "FLYING FORTRESS"

On the 50th Anniversary of World War II, the Air Force Museum Foundation Presents Its First Official Die-Cast Re-creation of the B-17G "Flying Fortress."

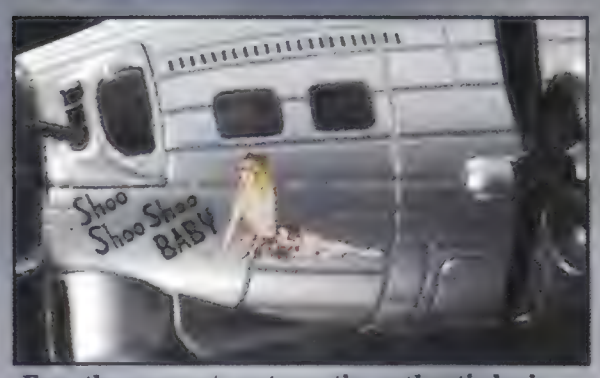
The B-17 "Flying Fortress." It was the very backbone of the Allied aerial offensive during World War II. Now, to commemorate the 50th anniversary of World War II, the Air Force Museum Foundation authorizes the authentic re-creation of a rare surviving B-17G that actually saw combat. It's called Shoo Shoo Baby, now on permanent display at the U.S. Air Force Museum.

Here is a remarkable die-cast model of the original, precision engineered of 111 components with a vast array of operating features. The propellers actually spin. The landing gear is retractable. The bomb bay doors open and close.

Shoo Shoo Baby also has astonishing detail. With a removable canopy that reveals the interior of the plane. Even the nose art re-creates the original's.

The price, just $195. A custom-designed display stand is included at no additional charge. Available only from Franklin Mint Precision Models.

Shoo Shoo Baby can be removed from its handsome display stand.



Even the nose art captures the authentic look of the original.

This aircraft was designed and engineered from the actual B-17G "Flying Fortress," nicknamed Shoo Shoo Baby. It has not been authorized or endorsed by any branch of the United States Military or its manufacturer.

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Although touted as the herald of a new age in transportation, the Fulton Airphibian is now only an artifact at the Museum's Garber Facility. Developed by Robert E. Fulton Jr. in Danbury, Connecticut, the flying automobile made its first flight on November 7, 1946. Separating its "flight unit" and "road unit" was described in the promotional literature as a "5-minute, 1-woman conversion." The Fulton's recommended speed was 45 mph on the road and 110 mph in the air.

bombing extends to the present day—perhaps the true legacy of the air war in World War I. (For more about the airplanes of this era, see "Wings of the Great War," p. 60.)

Two Engines, Jungle View

"One night over Laos, I lost the front engine," remembers Robert C. Mikesh. An Air Force major in 1968, he was flying a Cessna O-2 on a visual reconnaissance mission. "I immediately pushed that red button and jettisoned the external pods and started right to home. None of this going around that Cambodian leg. The hell with that—I was heading right to Pleiku."

Thanks to the Cessna O-2's rear engine, Mikesh got home safely. His story illustrates why the twin-engine Cessna O-2 was a popular airplane in Vietnam. It also explains why the Museum's recently retired curator says he still genuflects before the rear engine of the airplane he was flying that day, which has recently been restored at the Museum's Garber Facility in Suitland, Maryland.

In Vietnam the Cessna O-2 superseded the aging single-engine Cessna O-1 Bird Dog. The military wanted an airplane with a second engine that could bring a pilot home when one engine was damaged, and the O-2 fit the bill (although Mikesh was lucky it was his front and not the more efficient rear engine that failed). Flying at altitudes of 1,500 to 3,000 feet, the O-2 pilots flew forward air control operations, identifying enemy movements and designating a target with smoke rockets to direct an air strike.

Originally designed as the Cessna 337,

ROBERT C. MIKESH

a civilian airplane, the O-2 was modified for military work: it got a new instrument panel, lost the backseat to gain room for a radio bay, and was given a skylight to improve the pilot's visibility. A sight system was also added for the smoke rockets, which were carried under the wings for marking targets.

In the early 1970s, Mikesh was looking to add an O-2 to the Museum's collection and he recognized a familiar serial number on a list of available aircraft. Eventually his old Cessna will be part of an exhibit on the air war in Vietnam.

—David Savold

Museum Calendar

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700.

Symposium "From Vinland to Mars." Michael Collins, Thor Heyerdahl, and other explorers discuss the human urge to visit new worlds. Langley Theater, October 9, 7:30 p.m.

New Planetarium Show "Exploring New Worlds": history and future of exploration. Tickets: $2.75 adults; $1.75 children, students, and seniors. Einstein Planetarium, starting October 11.

New Gallery "Legend, Memory, and the Great War in the Air." WWI exhibit opens November 13 in gallery 206.

October 5 Monthly Sky Lecture: "The Space Show." Kit Stetser, NASM. Briefing Room, 9:30 and 10:30 a.m.

October 17 General Electric Aviation Lecture: Chuck Yeager, USAF (ret.) Langley Theater, 7:30 p.m.

October 29 Magellan Mission Lecture: "Venus Revealed." Magellan Mission scientists. Langley Theater, 8 p.m.

October 30 SAO/NASM 1991 Lecture Series: "The Beginning of the Universe." Kenneth Brecher, Boston University. Einstein Planetarium, 7:30 p.m.

October 30 Resident Associate Program Lecture: "Voyage into Unknown Skies." John S. Langford, Aurora Flight Sciences. Carmichael Auditorium in the Museum of American History, 8 p.m. Tickets: $8 RAP members; $11 nonmembers.

Planning a Smithsonian Visit?
The new VHS video *Guide to the Smithsonian* is an excellent aid for pre-visit planning. For ordering information and the free Associates' Planning Packet, write to Associates' Reception Center, Smithsonian, Washington, DC 20560, or call (202) 357-2700. Hearing-impaired visitors can use TDD and call (202) 357-1729.

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"I Can't Control the Airplane"

Alfred C. Haynes was the captain of United flight 232, a McDonnell Douglas DC-10, when the fan rotor in the tail engine disintegrated, a failure that caused the loss of all three redundant hydraulic flight control systems and rendered the airplane nearly impossible to fly.

Haynes and his crew, with the help of a DC-10 instructor pilot on board, were able to stagger to Gateway Airport in Sioux City, Iowa, where they crash-landed about 45 minutes after the hydraulic failure. Of the 285 passengers and 11 crew members aboard, 174 passengers and 10 crew members survived.

July 19, 1989, started out a beautiful day. First officer William Records was flying our aircraft, and the rest of the flight crew, having just finished lunch, were enjoying a cup of coffee and watching the world go by. Without any warning whatsoever there was a very loud explosion—so loud and sudden that at first I thought it was a decompression. But there was no rush of air, no change of pressure, and no condensation of the air in the aircraft. So I figured it had to be something else.

I saw Bill immediately grab the control yoke, and the red warning lights illuminated for the autopilot. He had cut the autopilot off, I thought, and I assumed he was taking over manual control. We had taken care of the first step in any emergency: make sure someone flies the airplane. We have had a number of accidents in commercial aviation because everybody was working on a problem—sometimes not even a big problem in the first place—and no one was flying the airplane.

I thought, now I can divert my attention to second officer Dudley Dvorak, and we can shut the engine down. We determined that the number two engine had failed, and at the time we thought that was all that was wrong. I called for the checklist and Dudley got out his book, laid it on the console, and read the first item of the engine shutdown procedure: "Close the throttle." But the throttle would not close.

Now, jet engines have become so reliable that I've never had to shut one down in flight. In a simulator you pull the throttle and it goes back. This throttle would not go back. That was the first indication that we had something more than a simple engine failure.

The second item on the checklist was closing off the fuel supply to the engine. But the fuel lever would not move either. Then Dudley said to actuate the firewall shutoff valve. This I could do, finally shutting off the fuel supply to the number two engine.

We were about 14 seconds into the episode when Bill said, "Al, I can't control the airplane." My focus quickly changed from the engine controls to the copilot. As I swung around, the first thing I noticed was that Bill had applied full left aileron, something that you would never see in the air, much less at 35,000 feet. Furthermore, he had the control column completely back in his lap, calling for full up elevator, something else you would never expect to see in flight. But what really caught my eye was that with the control yoke in this condition, the airplane was making a descending right turn, and at an increasing angle.

With all those pilots on board, I then said the dumbest thing I ever said in my life: "I've got it." Well, I took control of the aircraft, but I surely didn't know what I was going to do with it. Bill was absolutely right—the airplane was not responding to the control inputs. As it reached about 38 degrees of bank on the way toward rolling over on its back, we slammed the number one (left) throttle closed and firewalled the number three throttle. The right wing slowly came back up. I've been asked how we had thought to do that; I don't have the foggiest idea. I guess it was because there was nothing left to do. We had no ailerons to control roll, no rudders to coordinate a turn, no elevators to control pitch, no leading edge devices to help us slow down for landing, no spoilers on the wings to slow us down in flight or to help

In July 1989 Al Haynes found himself the captain of an airplane that could barely fly.

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The A.E.A. Silver Dart

In 1907, Dr. Alexander Graham Bell formed a group of aviators called the Aerial Experiment Association (A.E.A.). Their most successful aircraft was the Silver Dart, a wooden biplane with silk-covered wings, powered by a 35 hp Curtiss engine. On February 23, 1909, the Silver Dart flew for approximately three-quarters of a mile, and became the first powered, controlled, heavier-than-air aircraft to fly in Canada. Pictured on the cameo are A.E.A members John McCurdy and F.W. "Casey" Baldwin

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Above: The 10-coin display case. Left: The contemporary effigy of Queen Elizabeth II.

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AP/WORLDWIDE PHOTOS

The extraordinary efforts of the crew, culminating in a controlled crash, saved 184 lives.

braking on the ground. We had also lost control of the trailing edge flaps for landing, the nosewheel steering, and the brakes.

For the next few minutes we tried to fly the airplane with the yoke. It took both pilots to do it—the pressures on it were just too great for one person to handle. At the same time, while trying not to let go of the yoke, we had to work our hands around the frozen number two throttle and make a number of quick adjustments to the number one and number three throttles. We had to close one, open one; open one, close one. By adding thrust on one side and reducing it on the other, we could force the airplane into a skid to turn one way or another. But still we had no pitch control and just a slight amount of substitute steering capability.

In the meantime Dudley was on the radio trying to get us some help. Kevin Bauchman, who was on the radar console at Sioux City approach control at the time, became our primary contact with air traffic control services. He was backed up by a team of five controllers in the Gateway Airport control tower, co-located with approach control, who worked together to prepare for our arrival. When you have a serious problem like ours and need the kind of help that doesn't add to the tension level, a voice like Bauchman's, as calm and steady as it was, certainly is an influence. It helped us remain composed.

After about 15 minutes of talking to ATC and getting directions to Sioux City, we were advised that Captain Dennis Fitch, an instructor pilot for the DC-10, was one of our passengers. Considering the aura that surrounds flight instructors, naturally we invited him to the flight deck. Maybe he knew more about the systems than we did and could help us out. He arrived, took one look at the instrument panel, and that was it—the end of his knowledge too. He had never faced this situation either.

I asked Fitch to go back into the cabin and look at the controls. When he returned he reported: "The controls aren't moving. How can I help now?" We were still struggling with the yoke and the throttles at the same time, and again, out of the blue I made a decision. "Take the throttles and operate them in response to our commands. Take one throttle lever in each hand—you can do it much smoother than we can—and see if we can't smooth this thing out and get a little better control of the airplane." That's how we operated for the next 30 minutes.

After a while we began to realize that we had to work up some kind of system so that the airplane and the airport would be at the same place at the same time. We followed the formula normally used during descents in a DC-10: for every thousand feet you descend, you will travel three miles. We used that only as a guide, since we were certainly unable to maintain a consistent rate of descent.

We began a series of right turns because the airplane wanted to turn right all the time. That was one of the other little problems we had—we could not keep power the same in both good engines. If we ever allowed the throttles to remain at equal power settings, the aircraft would roll over.

As we got ready to land, Dvorak traded seats with Fitch and took control of the throttles. He responded to our calls—"We need a wing up," "Need to add power"—and Fitch added adjustment commands like "You need a little more," "That's not enough," and "We need a little less turn." It soon became obvious that although Dvorak was the regular crew member, of the two, Fitch had developed a level of expertise at this entirely new skill. Fitch had been handling the throttles for about 20 minutes and had a feel for what we needed. Dvorak, of course, did not have the benefit of that practice. At Dvorak's suggestion, we decided it was better that Fitch sit by the throttle controls. Dvorak gave Fitch his seat and took the jumpseat behind me.

We got down to about 3,500 feet and couldn't believe it when we saw a runway straight in front of us. But it turned out to be runway 22, and Bauchman was vectoring us for runway 31. Three fire trucks were sitting in the middle of 22, and Bauchman had only two minutes to get them out of the way. It was the only time I heard his voice crack—but then he fell right back into his calm, soothing, here-it-is voice. (When I had the opportunity later to compliment him on his coolness, he told me that he had transferred to Sioux City because he found his previous duty station too stressful.)

Just as the airplane came over the trees, it decided it was going to start down. The nose went down, the rate of descent increased, the airspeed increased, and we hit the ground.

We first touched down on the right main gear, the right wingtip, and the number three engine. (The right gear gouged a hole 18 inches deep, 12 of them through solid concrete.) The nosewheel made contact almost simultaneously, and then the left main gear slammed into the ground. As we hit, the tail broke off. The right wingtip also broke off, spilling fuel on the ground and causing a fire as we slid along the runway. At this point I think the left wing began to fly again and it came up. With no weight in the tail, the airplane bounced on its nose three times. We became airborne again, then came back down; fortunately for us flight crew members, the cockpit broke off from the fuselage. It was unfortunate for most of the first class passengers, however; their exposed section of the fuselage bore the brunt of the damage. The aircraft came to rest in a field to the right of the runway.

Imagine being a passenger and being informed that you are going to experience the hardest landing of your life. When I made that announcement I didn't realize what an understatement it was. But I warned them that it was going to be rough, to listen to the flight attendants, and to assume the best brace position. They went through a horrendous crash, a tumbling so tremendous they lost all control of their arms and legs. Fortunately, they were restrained by their seat belts.

Because the fuselage was on its back, the passengers ended up upside down, with smoke, fire, and debris all around. When they finally got out of the airplane they found themselves standing in a field of corn eight feet high. I cannot imagine what they felt like. But they stayed calm and helped one another. One of the survivors started climbing out of the airplane and heard a baby crying; he went back inside, found the baby in an overhead bin she had fallen into, and brought her to her family, which had been driven out by the thick smoke.

Rescuers initially ignored the separated cockpit because it had been compressed to a waist-high section of wreckage that looked like an uninhabitable piece of junk. When we were discovered inside and alive after 35 minutes, however, they pried us out—very carefully, because the four of us were confined in a small area and had a wide range of injuries.

Records had broken both hips, eight ribs, and a toe, and had numerous bruises and contusions. Dvorak suffered a shattered right ankle, multiple bruises, and contusions; today he has three pins in his right leg, his ankle is aimed a little bit off to the right, and he has a permanent limp. Eventually he will have to have the ankle fused. Fitch had multiple bruises, contusions, a broken rib, internal injuries, a severed nerve in his right hand, a broken right arm, and a dislocated left shoulder. I was relatively uninjured, with a slight cut on my right ankle, bruises, contusions, and a black eye, but I needed 92 stitches to close lacerations on my head.

Records, Dvorak, and I were back at work approximately three months later; Fitch, with the most serious injuries of the flight crew, was back in about 11 months. Regrettably, 111 passengers and one flight attendant did not survive the landing. My deepest sympathies go to their friends and family.

Adapted from the June 1991 issue of the Flight Safety Foundation's Accident Prevention.

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HANK CARUSO

Parting the Water

Recently I heard about plans for an exciting new military aircraft: the Water Scooper, a jet that refuels in flight simply by slurping a few thousand gallons from the ocean. Imagine being at the controls of that baby. You're fearless fighter jock Brad "Steampuff" Stokes, blasting through the skies when the needle on your H_2O gauge begins waving for help. "This pelican needs a drink," you mutter, screeching down to the Persian Gulf. Skimming the surface, you punch a button that lowers the belly scoop, gathering the vital sea juice. Jetting skyward, you snidely salute hundreds of idle oil rigs.

Could such a thing be? According to Stanley A. Meyer, a Grove City, Ohio inventor who has the booming voice and can-do personality of a high school football coach, it can. Meyer holds some 25 patents on various devices involved in what he calls Water Fuel Cell technology, a method of efficiently splitting water into its two combustible components, hydrogen and oxygen, then delivering and burning them safely in order to power autos, jets, and just about anything that requires energy. I heard Meyer describe the Water Scooper in a lecture he gave in a hotel near Grove City last April. He also played a videotape showing what he says is a working H_2O-powered car, and described his progress in "retrofitting" Water Fuel Cell technology to a Jet Commander.

As fans of popular science magazines know, you certainly can burn hydrogen and oxygen. The space shuttle does. Many observers consider hydrogen the Miracle Fuel of Tomorrow, since it burns with little environmental impact—the exhaust is water. Auto makers have built prototype hydrocars that may be on the market in a decade. As an aviation fuel, hydrogen has suffered from bad PR ever since the *Hindenburg* blew up, but a 1988 test of a hydrogen-powered Grumman Cheetah could help turn that around.

Of course, there are reasons why the bus you were stuck behind this morning was belching black smoke instead of steam. One obstacle is devising a large-scale hydrogen production method that makes economic and environmental sense. The most promising method is electrolysis of water—running a current between electrodes immersed in H_2O, causing hydrogen and oxygen gas to gather at the negative and positive poles. But unless you use electricity from an Environmentally Correct source—solar, wind, or hydro—you aren't really gaining anything. And solar-powered electrolysis is still under development.

Which brings us back to Meyer. His method involves what he calls "beyond the state of the art" electrolysis. There are several complicated steps, but cut to the bottom line. The key products are "highly energized...gas ions" that, when exposed to a spark, burn with "thermal explosive energy...beyond 2.5 million barrels of oil per gallon of water."

I'm no scientist, so I took Meyer's technical brief to the National Institute of Standards and Technology's Office of Energy-Related Inventions. The verdict was clear. All the bells and whistles of Meyer's "new" electrolysis don't change the fact that you can't get "more" energy burning hydrogen than you put in to get it out. In fact, Meyer's water-disassociating gizmology is an unnecessary, energy-wasting step in an engine that is actually running on battery power.

Meyer's patents for moving and burning hydrogen may be useful if it becomes widely available as a fuel. But that wasn't what brought about 20 people to the Water Fuel Cell dealership seminar I attended. They came to hear about water as fuel, and possibly to invest. Meyer is offering "Right To Do Business" options for $5,000 down, plus $45,000 due when the Water Fuel Cell product line is ready. His four-hour lecture was a revelation. The literature includes some errors obvious even to non-scientists (he says electrons can be "destroyed") plus a smattering of Jesus Physics. But in person he's an impressive cross between Professor Irwin Corey and Elmer Gantry. In a torrent of words he explains that the Lord showed him the secret of the Water Fuel Cell and that guardian angels keep his work "from falling into the wrong hands, like the Mafia or the Arabs." He tells of secret meetings with top military brass and government officials. In one meeting, he says, incredulous patent officials "foamed at the mouth and...vowed unto death that we would never get...the patent for this technology." Later, he speaks of people from the same demonic office as the best possible judges of the Water Fuel Cell's viability: "You cannot get patents on non-working devices," he proclaims. Which isn't true. The office grants patents for many non-working inventions. The NIST has a file full of them.

Of course, had I stood up and announced this I'd still be picking off the tar and feathers. Some of the prospects were obviously enthralled and ready to sign up. They seemed certain that in a few years they'll be rich, and the joke will be on the Arabs, the oil companies, and the government. I have a feeling, though, that once their $5,000 is burned up, they'll be left holding a commodity even more common than water: thin air.

—Alex Heard

THE 1966 FORD MUSTANG

Shown actual size.
Replica measures 7 ½" in length.

Photos depict replica not actual car.

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COURTESY MAX SAMUELL

Slim Lewis Slept Here

Bellefonte, Pennsylvania, had one brief, shining moment when airmail pilots used it as a stopover. Then they went away, leaving only memories.

by Donald Dale Jackson

The images still linger in their memories: the sound of an approaching motor, the mad scramble to the grassy field on the edge of town, the moment when the great light on the mailplane suddenly switched on, its beam flooding the waiting crowd. Finally the airplane would land, and as the ground crew closed in to refuel for the journey's next leg, the pilot would climb ever so casually from the cockpit.

Was it really 60 years ago that mailplanes landed nightly in the little central Pennsylvania town of Bellefonte, bearing a cargo of life and pride and excitement? Was it that long ago and more that daredevil Slim Lewis buzzed the courthouse and made the fish-shaped weather vane spin, and handsome Max Miller roared around town in his green Nash roadster? The town was even tinier then (population 3,996 in 1920,

During the 1920s, dozens of mail pilots touched down at Bellefonte's tiny airfield (left), seeking fuel for their aircraft and a little rest and relaxation for themselves. Decades later, mayor Jim Kerschner points out the only reminder of the town's airmail past (above).

SMITHSONIAN INSTITUTION

Surplus from World War I, the de Havilland DH-4 was the workhorse of the Air Mail Service for nearly eight years.

6,200 now), but during the 1920s it performed a vital service as the first airmail refueling stop in the nation. To be young in Bellefonte in those adolescent years of American aviation was to be part of something wonderful.

Jim Kerschner, 67, a former radio station manager and now Bellefonte's mayor, is one of several men who grew up in that era and never got over their infatuation with flying. "You can't conceive how exciting it was," he says. "Every time I saw a plane I'd go look. The big kick was going to the field to watch the night mail come in. I'd nag my dad to take me even though it was way past my bedtime, and when I got older I'd ride my bike. There were usually 25 or 30 people there. In my six-year-old mind those pilots were gods. I never had the audacity to speak to them."

Max Sampsell, a retired store manager, remembers teachers dismissing classes whenever an airplane landed. "My second or third grade teacher let any of us go who wanted to," he says, "and we'd get there somehow even though the strip was three miles away. We'd cut across farm fields." A B-29 gunner in World War II, Sampsell found the terrific illumination of the mail airplane's headlight "brighter than anything I saw until I was over Japan in a bomber."

For 87-year-old Edna Barger, Bellefonte's glory years meant lobsters. Her father was a dentist who treated the pilots at discount rates; in return, the fliers brought him buckets of live lobsters from New York. "My father would come back from the field," Barger recounts, "and the next thing I knew lobsters were crawling across the kitchen floor."

"I'd hitchhike to the field with a friend pretty near every day after school," recalls Jim Saxion, 78, who retired as a furniture refinisher at nearby Penn State University. "It was just fun, riding in the rumble seat to the field with our hair flying. We'd stay and watch until the mechanics went off duty. Other times we'd go to the train station to see the 8:16 come in from Milesburg. Those were our mainstays."

The seeds of Bellefonte's glory were planted when the government began the Air Mail Service in 1918. That year the service sent veteran pilot Max Miller on a survey flight from New York to Chicago in search of a suitable refueling stop. Bellefonte residents were elated when the airmail operation chose their town, whose distance from New York made it a convenient landing spot for fuel-thirsty airplanes. Daily flights between New York and Chicago, with the first westbound refueling stop at Bellefonte and the second at Cleveland, began in the summer of 1919; transcontinental service was in place by 1920. When the Air Mail Service built a chain of beacons enabling transcontinental night flights in 1925, the Bellefonte installation was moved to a larger field southeast of town. By this time airmail operations had overcome a somewhat shaky start, reaching a peak of efficiency

and public acceptance. These were the days of daring lone mail pilots struggling in fragile biplanes against bad weather and inhospitable terrain. Indeed, airmail charmed the entire country. In 1924 postal workers in San Francisco declined to mail to New York a man who had covered himself with $718 worth of airmail stamps.

The mail pilot who is remembered most warmly in Bellefonte is lanky Harold "Slim" Lewis. "He was the which than which there was no whicher," Jim Kerschner says; "a showman, a hail fellow, a good pilot and well liked." Considered the ace of the whole bunch, Lewis always seemed to get through, even when other pilots couldn't.

Slim Lewis stories are part of the town's aerial lore: Slim diving repeatedly to scatter a herd of bulls owned by a farmer he disliked, Slim buzzing freight trains and unnerving brakemen, Slim punching a hole in a wing by skimming a mountaintop and then complaining because he lost a fountain pen in the process, Slim dropping the Sunday paper to a friend who lived out of town. "Whenever a plane would swoop low over town we just figured it was Slim," recalls 82-year-old Phil Wion, a former schoolteacher. "We associated him with derring-do." Lewis survived his airmail career to become a commercial pilot; he died in Wyoming after retiring from the airlines.

Another favorite was Jack Knight, who became a celebrity when he made an all-night flight from North Platte, Nebraska, to Chicago on an unmarked route in 1921. When he landed in town shortly after getting married, the ground crew dressed a mechanic in a bridal gown and chauffeured Knight and his stand-in bride around Bellefonte in a truck orna-

LEE BATTAGLIA

A weather vane atop the courthouse drew mischievous fliers, who flew close enough to make it spin (above).

Charlie Ames (right) had always beaten the odds flying in bad weather, but his luck soon ran out.

CHARLES SAMUELS

Bellefonte Remembers

Although the local high school is built on top of what used to be the first airfield, Bellefonte's youngsters have little or no knowledge of the town's former role. The memories of the first airplane landing, of pilots squiring girls around in convertibles, and of the pride in seeing Bellefonte mentioned repeatedly in the newspapers belong solely to the generation born before 1930.

Born in Bellefonte, Edna Barger once worked as a dental hygienist. In her 87 years, she has never flown in an airplane. "I never took my feet off the ground," she says, "because I was scared to death." Many of the local girls had a crush on dashing pilot Slim Lewis, but Edna wasn't one of them.

Hugh Manchester (top, pictured with his dog Odie) has become Bellefonte's unofficial town historian. Max Sampsell (above), who retired from managing an auto parts store, served as a B-29 gunner in World War II. Phil Wion, 82, a former schoolteacher (right, middle), remembers when pilots checked into the Brockerhoff Hotel (right, bottom). Today the building is a retirement home.

Though residential development and increased population have turned Bellefonte into a bedroom community for nearby Penn State, the town still retains its turn-of-the-century charm.

mented with bells, shoes, and the tail section of a defunct mail airplane.

Pilot "Wild Bill" Hopson dropped airborne love letters, weighted with bolts, from airfield clerk Charlie Gates to his girlfriend in nearby Hecla Park. Hopson once kept a date in New York by climbing onto the wing of another pilot's loaded aircraft, snuggling close to the fuselage, and holding onto the guy wires for the chilly two-hour ride.

The aviators were part of the life of the town. They stayed at the Brockerhoff Hotel or boarded with local families, played on local baseball teams, and flew exhibitions for the townfolk. "There was an intimacy between the pilots and the town," says retired newspaper editor Hugh Manchester, another Bellefonte boy smitten by the romance of flight. "If they spot-

COURTESY ROBERT HINES

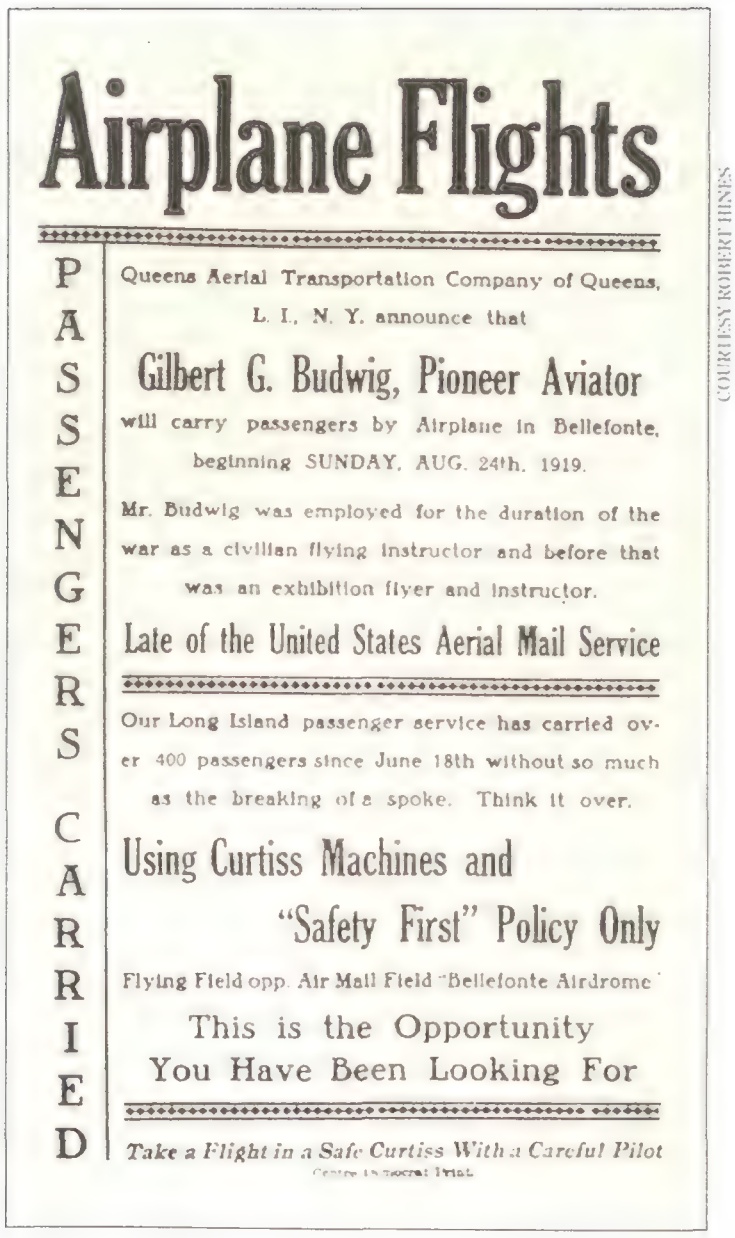
Night operations in Bellefonte began in 1925 with the opening of a beacon-equipped landing site outside of town (left). A cable and part of the hangar's concrete floor are all that remain of the airfield today (below).

LEE BATTAGLIA

ted a fire they'd buzz the house to make sure people were awake. They were heroes to the kids, girls as well as boys."

Other aviation luminaries turned up in Bellefonte in the 1920s and early 1930s. Wiley Post and partner Harold Gatty, Amelia Earhart, Eddie Rickenbacker, Will Rogers, Admiral Richard Byrd—all landed their aircraft on the little field at Bellefonte. often forced down by the always-chancy weather over the Allegheny mountain range.

Charles Lindbergh dropped by in the early 1930s. As Manchester recounts the story, the manager of the Bush House hotel took one look at the coveralled flier and concluded that he was a poor risk for the $1.50 room charge. Luckily, somebody recognized the Lone Eagle. Because of the late hour, he had the whole dining room to himself. Lindy



COURTESY ROBERT HINES

showed up again a few years later, and this time a crowd thronged to the field when word spread that he was coming. Spying the mob as he approached the runway, Lindbergh pulled up, sending the disappointed spectators home. Ten minutes later he returned to the empty field and landed. "I think we all followed Lindbergh and Amelia Earhart and the rest a lot more after the airmail came here," says Sampsell.

Aeronautical prominence was heady stuff for a town whose political and economic muscle, along with its population, had been waning since the 19th century, when Bellefonte produced five Pennsylvania governors. The 1925 move to a larger airfield occasioned a civic celebration. The Kiwanis Club served sandwiches; the Odd Fellows band performed. Phil Wion, wearing his blue serge uniform with the gold stripe, played the trombone. "We were proud because Bellefonte was a main stop," he recalls. "We played the national anthem and marches. It was a big occasion."

"We felt like we were part of something," says Manchester, the unofficial town historian. "When I was 14 I went into an airline building at the 1940 world's fair in New York and saw an aviation map of the country and there was Bellefonte! We were literally on the map. Oh, there was pride here then. And another big thing, remember a movie called *Ceiling Zero* with Jimmy Cagney in the 1930s? There's a scene where a pilot is calling Bellefonte airport: 'Come in, Bellefonte.' It's right in the movie. I suppose the airmail years were like the Golden Age of Greece for us."

COURTESY HUGH MANCHESTER

COURTESY ROBERT HINES

A 1919 ad (opposite) from Bellefonte's newspaper, the Centre Democrat, *hastened to assure readers that flying from the first field (left) was safe. The same year, fire destroyed these wooden hangars.*

There was, however, a dark side to Bellefonte's fleeting fame. The long, low ridges that roll across central Pennsylvania like waves on a choppy sea—hard to read from the air, prey to violent weather changes, and short on flat clearings for forced landings—were dreaded by pioneer fliers. Those who endured the area called it the "Hell Stretch." A 1921 mail pilots' manual shows what they had to contend with: "On top of the mountain just south of a gap in the Bald Eagle Range at Bellefonte may be seen a clearing with a few trees scattered in it. This identifies the gap from others in the range. The mail field lies just east of town and is marked by a large white circle."

With aviators forced to navigate by landmarks over mountainous country in rough weather, crashes were inevitable. Between 1918 and 1927, 43 postal pilots were killed. Charles Lamborn, who boarded with the Bellefonte undertaker, died in a crash just a few weeks after regular flights began when his DH-4 somersaulted to earth from 6,000 feet. Field clerk Charlie Gates flew to Cleveland one day in September 1920 with Walter Stevens, another Bellefonte favorite. On landing, Stevens asked Gates if he wanted to go on to Chicago, but Gates had a date in Bellefonte and decided to take the train back. Less than an hour later, Stevens died when the fuel tank on his Junkers Larsen J.L.6 exploded.

Irving Murphy was luckier. When his airplane crashed in

Before he put Bellefonte on the map, Max Miller (left) was a teenage runaway who worked at sea.

A radio station established in Bellefonte to transmit weather data in 1920 was one of only four in the country (below). That wasn't all the town could boast about, according to a 1928 airmail envelope (bottom).

COURTESY ROBERT HINES

COURTESY JIM KERSCHNER

"Wild Bill" Hopson looked invincible in a winter flightsuit, but death claimed him in a 1928 crash.

flames on Max Sampsell's father's farm on the edge of town, "my dad cut him free and rolled him on the ground to put out the fire," Sampsell remembers. Murphy eventually recovered, thanking the elder Sampsell with a gold watch. And Max Miller, the man who discovered Bellefonte for the airmail service in 1918 and for whom Sampsell was named, died in a fiery crash two years later, the year Sampsell was born.

The disappearance of pilot Charlie Ames in 1925 put Bellefonte on the nation's front pages. Ames vanished on October 1 en route to Bellefonte from New Jersey on a night when clouds sagged below the Allegheny peaks. Field clerk Gates anxiously checked nearby emergency strips and then stood on the field, listening for an engine that never came. More than a thousand searchers combed the hills east and west of town for the next nine days. Finally Ames' splintered aircraft and broken body were found near the summit of a mountain a few miles from the Bellefonte field. Longtime residents can still point out the gap in the Allegheny mountains that the courtly, well-liked Ames missed by about 200 feet. Manchester has the cushion from Ames' cockpit seat with the airplane's number, 385, on it.

Bellefonte's last airmail fatality occurred in May 1931, when pilot Jimmy Cleveland died on a mountainside south of town. Forty years later the dead pilot's brother, accompanied by Jim Kerschner and Hugh Manchester, among others, found remnants of the airplane and had a granite marker placed at the crash site.


NASM

When a pilot was killed, someone from the town would escort the body back to the pilot's hometown, no matter how far away it was. Though saddened by the death of any pilot, the people of Bellefonte understood that the deaths were part of the pioneering process. Indeed, many of the crashes came in the first two years of operation as the Air Mail Service, eager to win Congressional funding, hurriedly trained pilots and set up routes.

Bellefonte's bittersweet interlude as an airmail stop came to an end in 1933. The official reason was bureaucratic: the federal government ruled that commercial aircraft could not use fields belonging to the Department of Commerce, as Bellefonte's did because of its radio and weather stations. But the truth was, Bellefonte had become obsolete. Now the mail was carried—along with passengers—on gleaming new long-range commercial transports that had no need to stop in the tiny town. Although Bellefonte continued to operate its radio and weather stations, the refueling service was moved to nearby Kylertown, and even that seldom-used airfield was retired after the introduction of long-range DC-3s.

For nine-year-old Jim Kerschner, life was suddenly drained of excitement. "I went back to the field and there was nothing going on, it was deserted," he recalls. "Then I went to the strip they moved to at Kylertown, 20 miles west. I wanted to see what it was that took it all away, and there was just this one dinky hangar. I felt terrible."

The airmail days turned Kerschner and fellow Bellefonte boys Hugh Manchester, Max Sampsell, and Dan Hines into lifelong aviation buffs. Hines, a former mailman who died in 1989, was the most obsessed. He amassed hundreds of photographs, wrote an unpublished manuscript about the airmail, and even sent airmail Christmas cards. "It was all he talked about," his nephew Robert Hines says. "The airmail was his life. I think it started because his brother Ellis was a mechanic at the field. Dan was forever saying, 'Did I ever tell you about this or that pilot?' "

Hines and Manchester both learned to fly on the GI bill after World War II, but both let their skills lapse after a few years. "I got a leather jacket, you know," Manchester recalls, "but then I went to college and then the GI bill expired. I guess I got the Baron von Richthofen out of my system." Sampsell took pilot training during the war but didn't get his wings because of a freeze on hiring; he became a B-29 gunner by default. After the war, with a Distinguished Flying Cross to his credit, "I wanted to fly and I didn't. I thought maybe I'd had enough thrills in the air. So I didn't follow up, and now I could kick myself." Kerschner had decided to take flying lessons, but another fatal crash near Bellefonte chilled his desire.

Phil Wion has been on an airplane only twice in his 82 years, but he knows what his hometown lost when the airmail decamped. "We were on the map," he says. "But now people just look at you when you say you're from Bellefonte. I tell them it's near State College. Then I say it's in the exact center of the state. Then I stop."

Bellefonte's original airfield is now hidden by the regional high school and a highway department building; across the street stand a Burger King and a mini-mall. The second field is a patch of farmland across from a lime plant. As Hugh Manchester walks across it, his eyes rise from the silent, empty field to the sky. "This is just about where the big jets start their descent to New York these days," he says.

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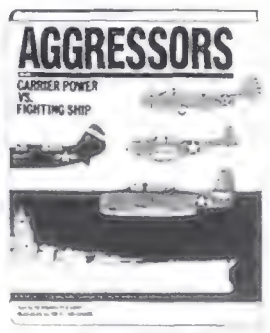

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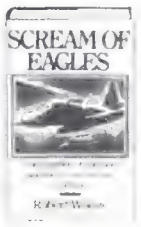

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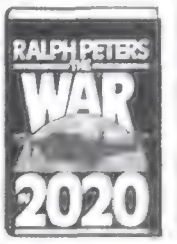

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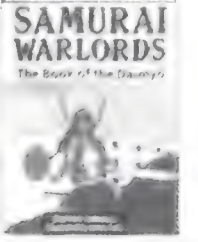

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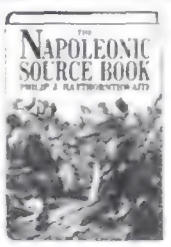

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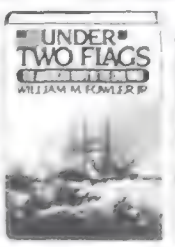

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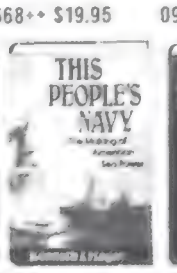

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ASP 10/91

Moving Day

by Stephan Wilkinson *Illustrations by Richard Thompson*

Building a kitplane is a one-person job. Getting it to the airport takes a cast of thousands.

I suppose there are worse things than watching the airplane you've spent six years and $80,000 to build being moved on a bouncing trailer from a remote upstate New York barn, across a rocky lawn traversed by a brook, down a steep driveway, along a one-lane country road, and then 20 miles down the highway amid Saturday traffic.

The only worse things I can think of, though, are old magazine photos of a country church being hauled down a road on a 64-wheel tractor-trailer while the advance crew dismantles traffic lights. Or of the little guy with a sledgehammer who's about to knock out the last wedge securing a frigate, allowing it to either slide sideways into Mobile Bay or roll over on top of him. Or of the entire Saturn V rocket being trundled to its pad, looking as tippy as a tower-of-champagne-glasses barroom trick.

Many people build airplanes at home. Well, a few do. But more do so every year, as sophisticated kits—giant model airplanes—become available. My Falco was arguably the most sophisticated kitplane on the market. There are others faster, more powerful, and more modern, but believe me, there are none as complicated. My airplane began in the spring of 1985 as a few sticks in the cellar; that summer they grew into a truncated tail section—vertical and horizontal fins, rudder, and elevator, the ghostly lot requiring an active imagination to foresee a Falco.

Going to school on that subassembly, I learned how to bend water-soaked plywood with a steam iron; how to measure in the individual millimeters so crucial to an airframe that would be fitted together as precisely as a pocket-watch; and how to follow the complex choreography of gluing, a dance that moves all too quickly to the finale of sticky fingers and misplaced clamps.

When the main wing spar arrived—a dihedral 26-foot-long splinter of finely wrought spruce, tapering from a center section thick as a railroad tie to hollow, airy tips—it was time to move everything to the barn.

With the airplane safe in the barn, it was a good 200 feet to the house, a distance I had considered an ample buffer for the construction technique known as "shouting it into place." Other craftspeople trim, wheedle, cozen, slide, or

tap components together. I swear at them, summoning the vilest curses, the most unspeakable, anatomically impossible terms, to humiliate the bafflement into relenting. The barn, unfortunately, turned out to possess the same acoustical magic that domed buildings often have, allowing two people standing far apart to speak at a normal conversational volume and hear each other perfectly. The phenomenon was revealed by my visiting mother-in-law, who sat reading and musing in our living room one afternoon, ceiling fan fluttering overhead, patio doors flung wide to the lawn that lay between the house and the barn.

"It's too bad Stephan hates working on the airplane so much," she said to her daughter.

"Hates it? He *loves* it," Susan answered.

"Then why is he constantly cursing it, poor thing?"

My father-in-law had even more trouble appreciating the undertaking. He never spoke, never smiled as he poked around the ever-increasing airframe and thought, *You brainless dink, all you've built is a pile of firewood trapped forever in an old shed, when my daughter could be driving three Lincolns.*

As winter fell heavily upon the Hudson River Valley, I retreated from the numbingly cold barn and began to assemble the airplane's entire electrical system and instrument panel on the kitchen table.

The electrical system kit arrived in a coffin-sized box and included everything from finger-thick battery cables to lightbulbs the size of grains of rice, as well as miles of slick Teflon-insulated wire, cut roughly to length and color-coded. Yellow wire with red, gray, and violet striping. Yellow wire with red, *blue,* and violet striping. White wire with *brown,* blue, and violet striping—every combination, it seemed, of nine colors and half a dozen thicknesses. Were I to misread a red stripe for an orange one, keying the microphone might stop the engine. Or perhaps retract the landing gear.

When people saw the airplane a-building, its wings stretching far wider than a door designed to accommodate a hayrick, the first question was invariably "How ya gonna get it out of the barn?" I never had any doubts, for I'd worked the whole thing out on paper, with a little scale outline of the airplane and a floor plan of the barn, its old stalls, and the tree trunk-thick doorposts the wings would have to fit between. But had I measured correctly?

If not, some serious regrouping would be in order, for the airplane was large (26-foot wingspan), heavy (well over half a ton), and at this point, quite unalterable. It was a superb all-wood Italian design of enormous strength and grace. Part of the strength and grace is due to the fact that the wings are permanently affixed to the fuselage in a flowing, sculpted interface. Most airplanes can be dismantled by unbolting their wings from the center section of the spar, but the only thing that comes off the Falco is the tailcone, allowing the airplane to be carried laterally—wings pointing fore and aft—on a flatbed truck.

Years ago Falcos were built in a factory in Milan, then taken to the airport on trucks, trailers, and, at least once, a horse-drawn cart. As moving day approached, I began to worry that my Falco's rollout would prove to be a far less routine journey.

The moving crew began to gather at nine on a Saturday morning—friends, friends of friends, friends' girlfriends, people I'd never even seen before. Among the first to arrive was George, a sinewy, ruddy-faced guy in a Navy cap who quickly took charge. He was a rigger, making his living manipulating huge objects ("George sees steel, his nipples get hard," explained his friend Tony). In minutes George had the Falco out of the barn and onto a borrowed trailer. *Hey, this is going to be easy,* I thought.

The crowd had grown, now evenly divided between experts and drones. The experts gave orders. The drones drank coffee. But no matter who did what, once loaded with airplane, the trailer wouldn't fit past the tree outside the kitchen windows. "Be my guest," George said with exasperation as Jim, an Adirondacker who handles a chainsaw with aplomb, substantially altered George's plan for chopping the handsomest limb off the tree without letting it crush my Falco.

Six-foot-six Gary, the photographer, did no lifting or toting. "I'm a prince," he said, only partly in jest. "I'm used to working with an assistant, and I'm all alone on this job." Gary dashed hither and yon taking pictures, occasionally backing off a porch, plunging up to his ankle in the brook, or stepping on his camera bag. "Steve! Stand here and talk to Jim. Make believe you're talking about taking that other tree down."

The Falco's tail was proving to be the most irksome component to move. Though light enough for two people to carry easily—and equally delicate—it was unwieldy, resembling a huge version of a child's jack missing a limb or two. To move it we needed another truck. Tony went to fetch one offered by a landscaper who's also a pilot.

Once the truck arrived, Jim became a flurry of activity, a househusband released for the day from tending his two little boys. "Got any tires? Old tires? How about some more of that foam rubber that's in the barn? Blankets! We need blankets." Four drones trotted past bearing the fragile tail and proceeded to toss it—*Oy, I can't bear it*—up into the truck, where Jim bedded it down and strapped it in like a gorilla being delivered to Clyde Beatty.

Listen, I'll go rake up grass clippings. I'd rather not watch. Lunch—yeah, I'll make lunch. With my wife away for the week, I'd indulged in all the supermarket excesses she loathes: nine pounds of ground sirloin, six-packs of imported

beers I'd never heard of, and boxes of Häagen-Dazs ice cream bars. By the time the hamburgers were on the grill, the crew had everything ready for the tow truck that would haul the trailer. When the Häagen-Dazs bars came out, drones and experts alike were offering to move the barn next weekend if I'd make lunch again.

While we waited for the truck, I recalled the dark thoughts that had occasionally plagued me as the airplane neared completion—images of the first homebuilt Falco to have been completed. First flown several summers ago, it was a stunning, glass-smooth little airplane built by a middle-aged Minnesota insurance executive. Soon thereafter, during a nighttime instrument approach to Gainesville, Florida, the airplane ran out of fuel and went down, killing its builder and a friend. Fast automobiles and high-strung airplanes carry with them a certain cargo of danger. To walk into a showroom and buy such a vehicle can turn out to be a deal with the devil, but to spend years lovingly assembling the instrument of one's demise would be a dreadful indignity.

The tow truck—an enormous van—finally arrived. It would be driven by an acquaintance who owns a company called Musical Waters, a hydraulic extravaganza oddly akin to that butt of David Letterman jokes, Dancing Waters. Bob towed his pumps and hoses, lasers and floodlights to conventions and fairs all over the East, so I figured he ought to be able to tow an airplane.

Soon the parade began. The police stopped traffic to allow our caravan—two trucks, a trailer, six cars with flashing lights, and a pickup that appeared out of nowhere—to pull onto Route 9W and head north toward Dutchess County Airport, near Poughkeepsie.

But to reach Poughkeepsie we had to cross the Hudson River on an interstate toll bridge, and the Falco was several inches wider than legal. We could hardly hope to slip through unnoticed, but Tony turned out to be a recently retired New York state trooper. "Leave it to me," he said. "They won't bother ya." I had trouble reconciling this pleasant middle-aged model airplane enthusiast with the stock state trooper image: campaign hat creasing a forehead just above mirrored Ray-Bans, frame slowly unfolding from a pursuit Mustang festooned with rotating red lights. But Tony, who led our parade in the truck that was carrying the Falco's tail, negotiated briefly at the toll gate and we instantly became a narrow load.

Drivers in other cars pointed, jabbered, and swiveled their heads as they passed, the Falco's bubble canopy and military-brown primer paint perhaps making it resemble some new, petite stealth fighter. Even more amusing were those who drove by without a glance, as though they saw airplanes being towed along highways every day. Worst of all, however, was the rusty, listing Pontiac that veered into the convoy right behind the trailer, intent on getting a really good look.

My daughter was chattering away in the sing-song Valley Girl voice of 11-year-olds everywhere. "I'm reading this really interesting book? By Suzanne Farrell? The ballet dancer?" I paid no attention. "Brook, tell me if you see anything loose on the trailer. Does the Falco's wheel look like it's moving a little? Jeez, is that rope loosening?"

"Dad, how can I distract you if you're going to worry all the way to the airport? Get a life." Like everyone else, she was far more rational about the move than I was. But none of them had built the airplane, had crawled through its innards, had agonized over every curve and conjunction, had sanded and smoothed and perfected for hours. Was it possible to transport such a delicate mass 20 miles without a disaster, without even a ding?

It was, and slowly I realized that the collection of wood and metal I'd sheltered so carefully for six years had better not be all that delicate. For it was not only going to the airport, it was beginning a real life, a life in which it would be rained upon, half-buried in snow, and baked by the harsh summer sun.

It would even fly—*there's* a thought—while the pounding of its four-cylinder Lycoming engine would rack carefully bonded joints and vibrate compulsively torqued fittings, and the Gs of aerobatics and bad landings would flex and bend an airframe that was not designed to just sit in a barn. Mud would splash its pristine landing gear and oil would streak its smooth belly.

It took 10 minutes to undo what had consumed an entire morning to create. The Falco came off the trailer and rolled into a borrowed hangar like a boxer bouncing into the ring. November 747 Sierra Whiskey was finally home.

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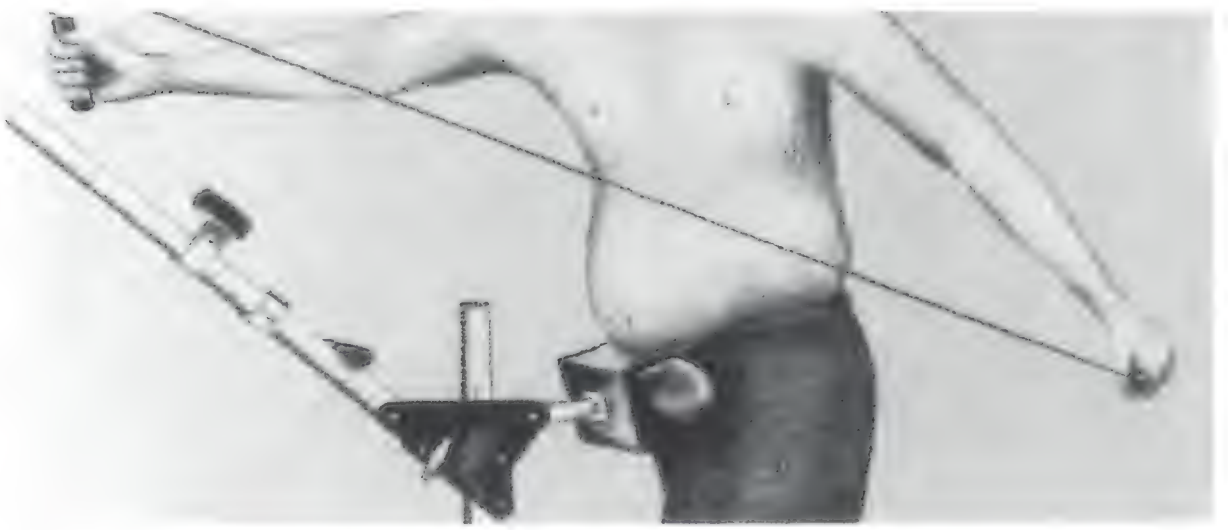

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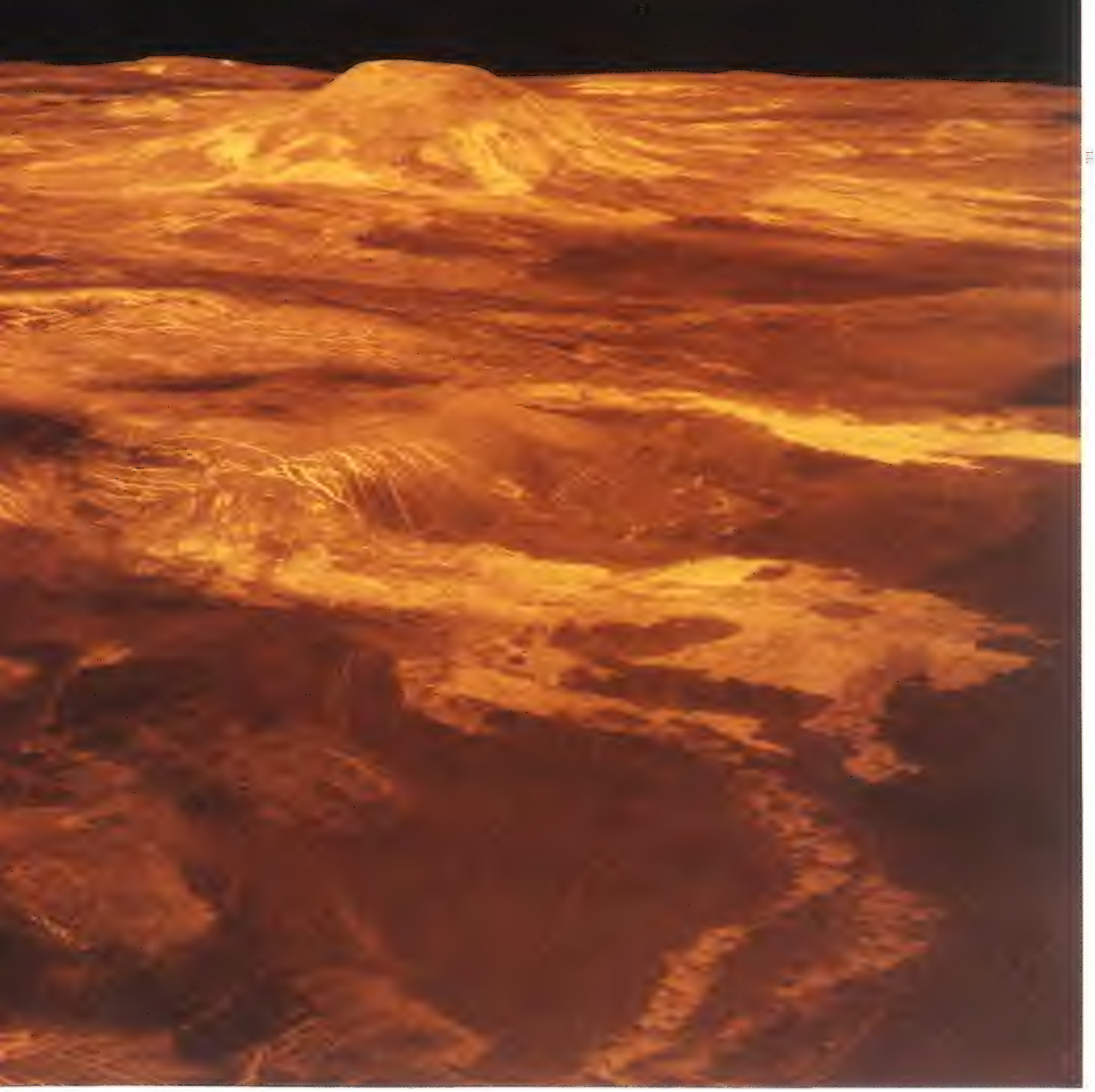
Fast Forward on Venus

Jet Propulsion Laboratory computers let scientists zoom around our neighbors in the solar system.

by Greg Freiherr



Besides adjusting the perspective for a sidelong look at these volcanoes, the computer tints the image orange to approximate what human eyes would see. Venus' dense atmosphere filters out blue light.

It doesn't *look* like a new technique for scientific observation and interpretation. It looks more like a video game. The difference is there's no joystick to control your speed or direction (or to blast your imaginary enemies), and that's really Venus there on your TV screen.

As the video begins, a craggy orange landscape slips by as if it were filmed from a spaceplane flying low over the surface. The craft descends, speeding past craters and scars. It noses gracefully around a mile-high volcano called Sif Mons. You get a good look at the webbed cracks along the volcano's slope before the craft accelerates over a plain, past impact craters tens of miles wide, deep into a valley, and up the side of another volcano, Gula Mons. Again the craft descends, chases a dark streak along the surface leading to two craters, and pivots for a last, long-distance view of the volcanoes. You have just flown a little over 5,000 miles at very low altitudes—from 300 to 2,000 feet—and at an average speed of 180,000 mph. Brought to you by NASA's Jet Propulsion Laboratory in Pasadena, California, the video is one of several very brief tours of the regions on Venus most intriguing to planetary scientists.

Jeff Hall, the primary animator on the Venus movies, punches up the video again on a keyboard in the semidarkness of the JPL Digital Image Animation Laboratory (DIAL). Behind the

screen that illuminates his face stands an essential part of the DIAL workforce: several banks of computers, one six feet tall, that have the capacity to sort and arrange the millions of numbers that translate into one two-minute video tour. Hall has been at the lab since 1986, when, with only one computer, he helped Kevin Hussey create the video that started it all. That was a proof-of-concept project that combined Landsat images with data from the Defense Mapping Agency to make a computer-generated flyover of the Los Angeles basin. Hussey called it *L.A.: The Movie*. After that, he applied the technique to data from the Viking orbiter, making *Mars: The Movie* from images of the Martian surface that were transmitted between 1975 and 1982. DIAL technicians are currently working on two kinds of projects: Earth-centered videos, such as animations of the dynamics of the ozone layer, which Hussey oversees, and movies of the other planets—the Solar System Visualization project, run by Eric De Jong.

The Venus videos are De Jong's creations. A planetary scientist at the California Institute of Technology in Pasadena, De Jong started his career at the Massachusetts Institute of Technology, where he worked on computer modeling of cesium plasmas. In August 1989 he worked with JPL during Voyager's encounter with Neptune, then applied for support to continue the work with data from other spacecraft. So began the Solar System Visualization project. That's "project" with a small "p," De Jong points out, explaining that expertise and funding come from several places to support the handful of people who help out on every video. "We couldn't do it without the team," says De Jong. "The solar system's a big place."

And it has been toured by many spacecraft. From Mariners 9 and 10, which visited Mars and Mercury in 1971 and 1974, the Viking orbiter, which sent back pictures of Mars from 1976 to 1980, and the Voyagers, which went just about everywhere between 1977 and 1989, NASA currently has on tap more than 145,000 images.

To make the Venus videos, De Jong has worked with archival data as well as fresh radar images transmitted by the Magellan spacecraft. Magellan arrived at Venus in August 1990, and has been mapping the planet ever since from a near-polar, elliptical orbit 183 miles above its surface (see "Venus on a Shoestring," February/March 1990). Magellan's radio signals are recorded on nine-inch reels of magnetic tape at the three centers of the Deep Space Network, then shipped once a week to JPL's Multi-Mission Image Processing Laboratory, where the binary codes are translated, recorded on photographic film, printed, and distributed. This is the way NASA has traditionally processed the information transmitted by planetary probes, from the pre-Apollo lunar orbiters to Voyager's latest encounter. The Solar System Visualization project adds an option.

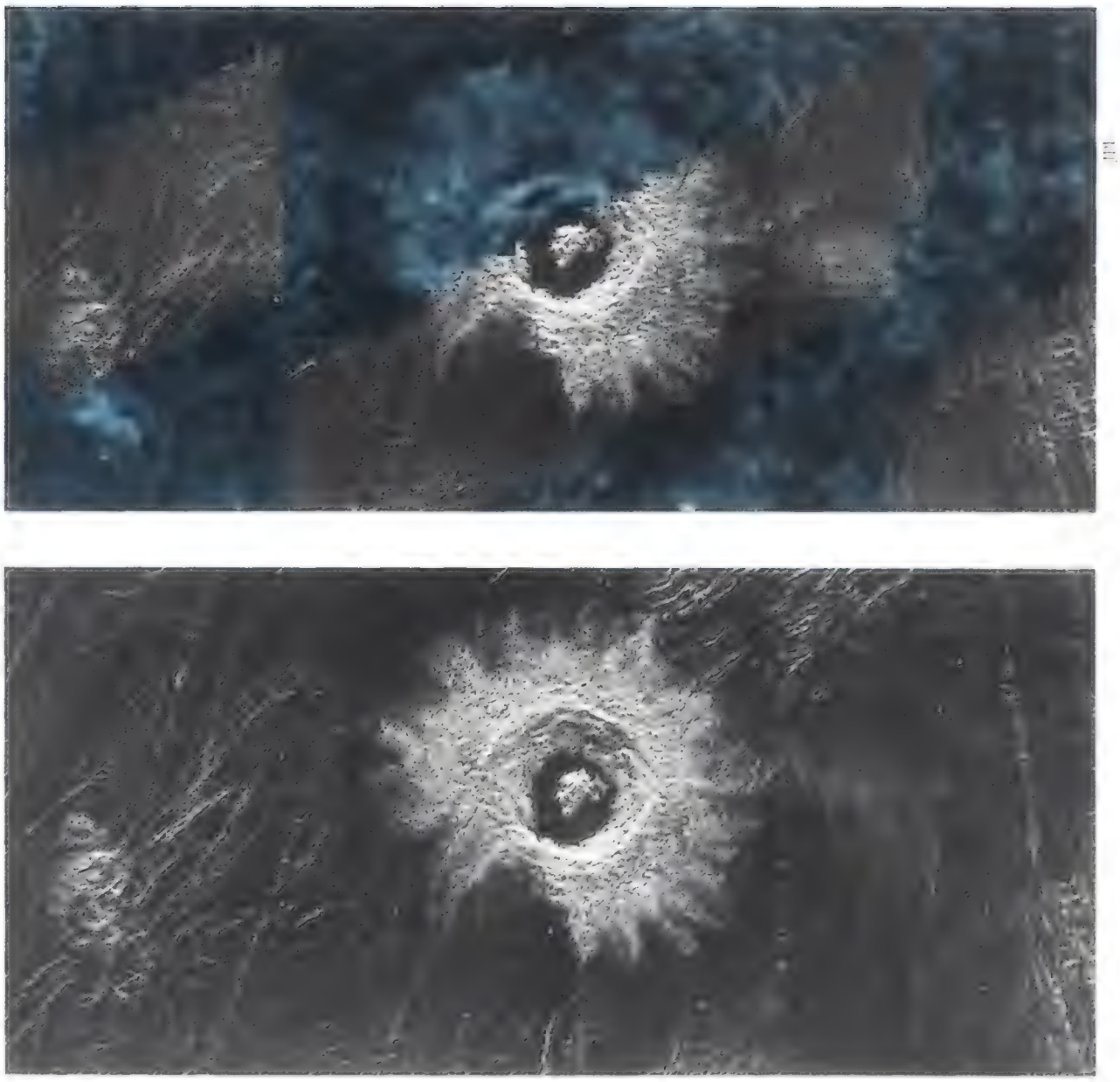
"I'm trying to develop new tools to make new discoveries and make new measurements," De Jong says. "We find that in the videos there are things that sort of jump out at you that you might not have realized before. For example, there is an unusual phenomenon on Venus not understood yet. Some materials are highly reflective to radar and these appear to occur at the highest elevations on the planet. But the distribution doesn't really have that simple relationship. The reflective material is between five and eight kilometers—a little higher, it disappears. If you have a 3-D view over large areas of the planet, you can begin to get a feel for where the deposits are."

Andrew Ingersoll, a planetary scientist at Caltech who was the head of the atmospheres group on the Voyager team, helped convince De Jong to pursue the Solar System Visualization project. "When you have a vast planetary surface and you've imaged it with thousands of images with not much overlap, but just enough so you can seam these images together, you have a problem," says Ingersoll. "Each one you could project onto a TV screen, if you have a high-resolution TV. But you can't look at all of them at once. And you can't get an idea of a global context."

Like ordinary analog films, the digital videos are created by stringing together a series of still images, not unlike the technique children use to create a flip-book. Each still image in turn is a checkerboard of thousands of tiny squares called picture elements, or pixels. Pixels are no more than small squares of gray, white, or black that together form an image. Each one is the visual representation of an eight-digit number, called a byte, composed of ones and zeros. The eight digits in each byte

Animators Jeff and Betsy Asher Hall make both kinds of DIAL videos. Betsy animates atmospheres; Jeff does flights.

CHAD SLATTERY



Fuzzy 1983 Venera images of a 21-mile-wide crater (highlighted in blue, top) were filled in by Magellan data.

afford a possible 256 different combinations, each one expressing a different degree of brightness.

The computer processes two distinct sets of Magellan's data—two bytes—for each pixel: radar brightness measurements, which, taken together, show shapes, structures, patterns; and altitude measurements, which provide the planet's elevations. "It is crucial to register the image data with the topography; otherwise you may have valleys on the top of mountains or mountains at the bottom of valleys," says Jeff Hall.

Each frame of the video is a rectangle, 640 pixels wide and 480 pixels long, for a total of 307,200. (The number of pixels used is limited by the resolution of the video screen. Magellan images have a much greater resolution, thousands of pixels square, but the video screen isn't capable of handling such a mass of information.) Each video contains about 4,200 frames. If all those pixels were represented as the raw series of eight-digit numbers, they would fill entire rooms with typewritten pages. To turn this vast amount of digital information into one two-minute animation, the computer runs continuously for eight days and nights.

De Jong and Magellan project scientist R. Stephen Saunders determined the areas of Venus that would be the most promising subjects for the videos. One focuses on Maxwell Montes, the highest mountains on the planet, one slightly higher than Everest, and their relationship to their environs; another flies over Alpha Regio, a fragmented plain that is highly reflective and so became one of the first areas on Venus visible to Earth-based radar. A third examines the two volcanoes, Sif and Gula.

Long before Magellan had even entered its orbit, De Jong and the DIAL technicians had completed the first of the Venus videos, a simulated flight based on data from U.S. Pioneer spacecraft and Soviet Venera orbiters, launched almost a decade ago. When Magellan images became available, technicians substituted them for the older data, and suddenly the view was ten times more detailed. (Magellan's sensitive radar is able to distinguish surface features the size of a football field.)

In the lab, Jeff Hall sits at the computer screen and demonstrates one of the steps in making the Venus video. A few hundred square miles of Venusian real estate glow on the screen. There are maybe ten Xs on the landscape, each representing a point of interest. Blue and green lines run from the Xs along particular fields of view. The view from each X represents what Hall refers to as a "key frame." "The key frames are like bus stops," he says. "We know where we want to go, but we still have to generate the route to get there."

But the radar image is strictly an aerial view, so how can the video offer views of the sides of canyons and the slopes of volcanoes?

"It's an interpretation," says David Okerson, an engineer with the Science Applications International Corporation, a NASA contractor. Okerson is the Magellan program engineer. "Those perspective views are being generated from the computer using the SAR [synthetic aperture radar] image, draped on top of a model of what the surface's shape is like. It says, 'Ah, I know what this scene looked like when I looked straight down on it, and also I know what shape it is. Therefore, if I were down here'—and you stick a pin in the thing—'at one kilometer above the surface'—and you put the head of the pin at that height—'and then I look to that direction, what would I see? I would see this side of the volcano because it's toward me but I wouldn't see that side of the volcano because it's away from me.'

"We started from one big mosaic—40,000 by 40,000 pixels, really big—and then we stuck a whole bunch of pins in there to trace the route of our flight," Okerson says. From the location of each imaginary pin, the team determined the appropriate altitude and direction for the camera. "Then the computer calculated what the scene would have been from each of those locations looking at each of those directions," Okerson continues. "We compute about a dozen favorite spots and then we tell the computer, 'Fit a smooth curve that goes through all those positions' and the computer then goes in and hammers a whole lot of pins in at all the intervening positions."

Some of the key frames are bunched

together; others are far apart. The ones close together are typically on a curve. "Just like driving a car," Hall says. "When you're on a winding road, you're paying a lot of attention. You've got a lot of adjustments leading up into a curve, going through it, and coming out. When you're on the freeway, you're just kicking back; it's no big deal."

The number of frames between two points determines the travel time. If the surface has no points of interest, relatively few frames are put in and the viewer rockets over that stretch. Put in a lot of frames and the viewer seems to hover over that area. "Once you've defined what you want to see on the surface it's a straightforward calculation, and that's when we just go in and let it crank for a while," De Jong says.

Besides the visual thrill that any viewer gets from being transported to Venus and given a fast ride over ridges, calderas, and mountains, a scientist gets a much stronger impression of the surface features in three dimensions.

"A person's perception of three dimensions has a number of psychological and physical cues," explains De Jong. "After all, the image on the back of the retina is a flat, two-dimensional image. But lighting and shapes help communicate depth. And motion cues are very important."

To understand how motion helps define a surface in three dimensions, you need only hit the "pause" button on your VCR. Whatever depth and contour characterized the moving scene abruptly disappear. Start the tape moving again and lava flows have direction, valleys and ridges have relationships; mass, weight, and depth return.

"Flat, two-dimensional representations can sometimes be misleading not so much on a very small scale but on kind of a large scale," says R. Stephen Saunders. "It may be something as basic as seeing that a landform is a long trench or seeing the relationships between things like faults, fractures, and folds."

In one Venus video, Saunders noticed a flow of lava that appeared to break the laws of gravity. "Everybody knows that fluids have to flow downhill," he says. "That the lava flow seemed to go up told us that there's been some deformation since the lava formed. That

CHAD SLATTERY

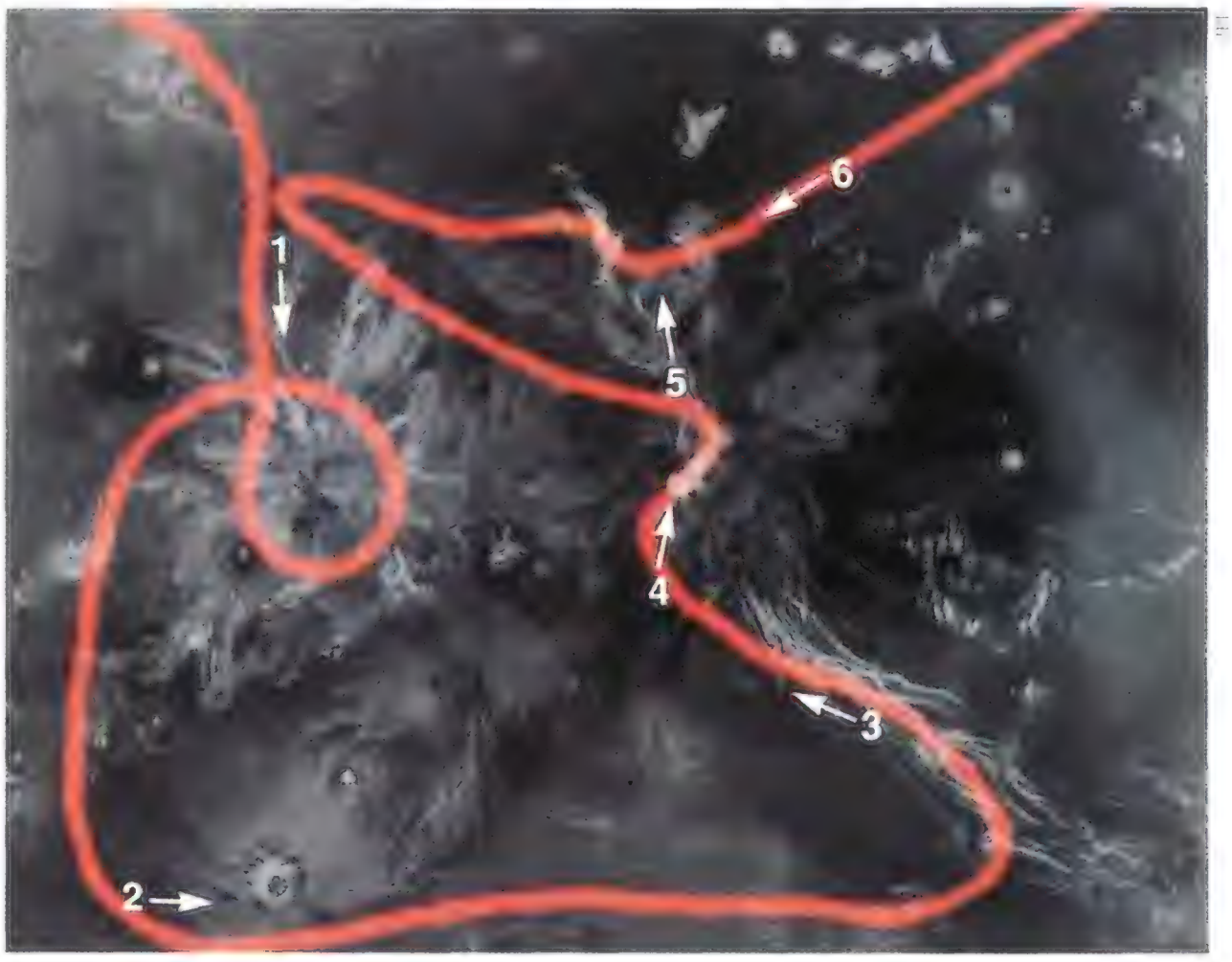
can be important in working out the sequence of forces affecting the surface of the planet."

Another observation resolved a debate about a crater-like depression called Cleopatra. Some believed that Cleopatra was formed by volcanic eruption; others thought it was caused by the impact of an asteroid. The video proved that both camps were correct. "Looking at it in 3-D you can clearly see that there are lava flows, but it is even more clear that the crater was formed by an asteroid impact," De Jong explains.

In addition to the flyovers of planetary surfaces, the Solar System Visualization project has produced animations of the atmospheres and storm systems of Jupiter, Venus, and Neptune. During De Jong and Ingersoll's first collaboration, they were hoping the technique would give them a fast track to some answers about Neptune's Great Dark Spot in time for the last Voyager press conference.

One of the first discoveries made during the 1989 flyby, the Great Dark Spot had been eluding scientists' attempts to determine whether it is a rotating storm system, like the Great Red Spot of Jupiter, or a stagnant region of dense gas. "Our traditional method of measuring winds involved finding very small clouds that act as tracers," says Ingersoll. "But the clouds that were near the spot would come and go. They were gone before they had moved far enough for us to measure them." De Jong adds: "A lot of work went into that effort with absolutely zero results."

Visualizing Venus requires both man—Eric De Jong—and machine, the Magellan radar mapping spacecraft (above). To develop the computer-generated flight path around Sif and Gula volcanoes (below), De Jong started with a large mosaic of the surface and marked six key views. The arrows show the vantages from which those views are seen.



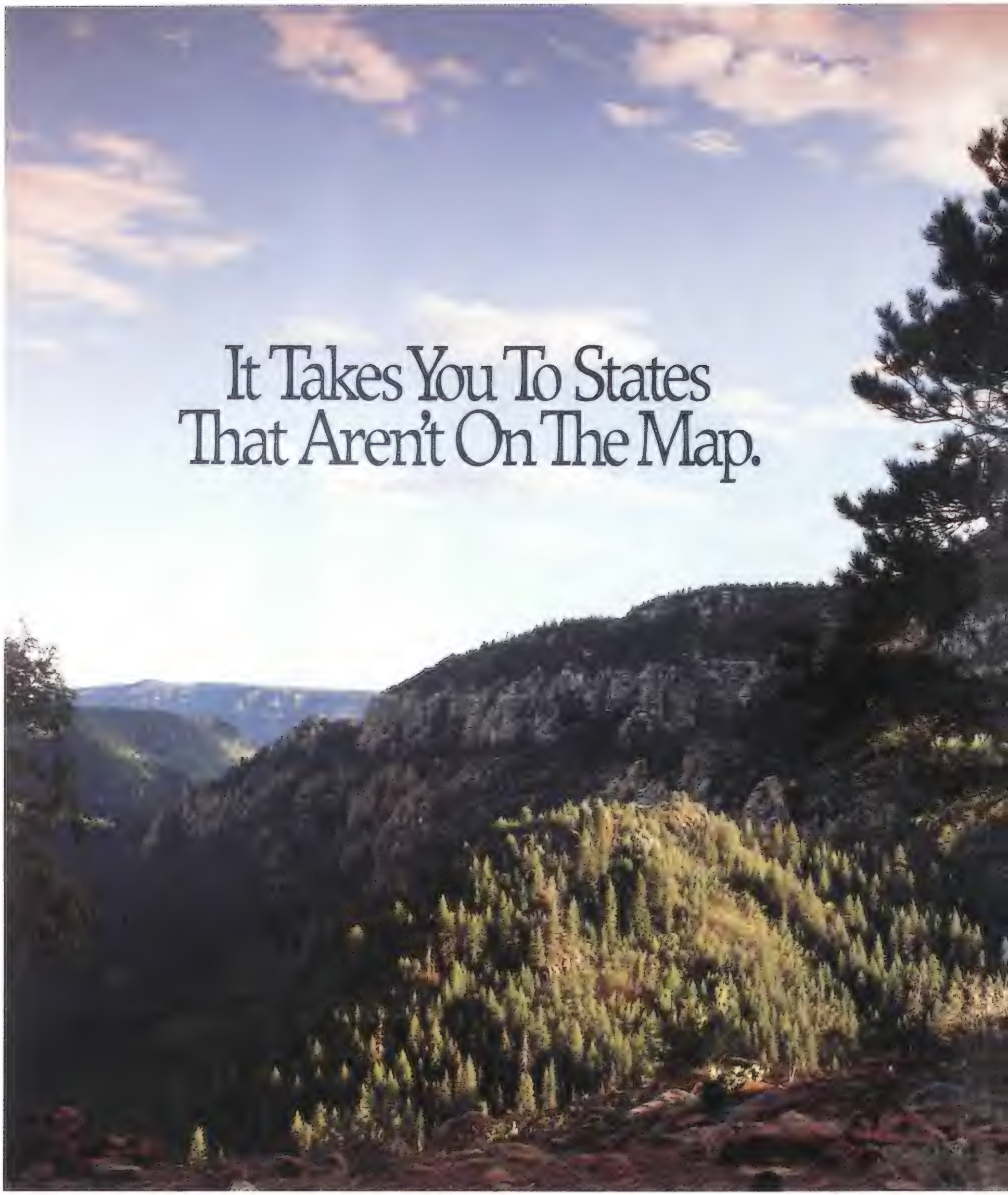
The highly reflective area in this Magellan image of Venus is lava that has flowed from the dark circular pits.

De Jong's approach was to choose a series of 29 images, taken when the spot was at the same location on the planet, arrange them in chronological order, and string them into a video animation. The first time the team watched the videotape De Jong made, however, they weren't sure they had found what they were looking for.

The images had been taken at 18.3-hour intervals, the period of the spot's revolution around Neptune. "Over that period of time, from one image to the next, you could see that it was changing a lot in form," De Jong says. "Can you see it rotate? You're not sure. The outer contours are changing, but you're not sure if it's rotating or flexing its muscles. You see it as 29 frames. Click...click...click...." he mimics the slow speed at which the image changes. "Your brain is not remembering the first frame to the 29th. But if you get it fast enough, there's practically enough remembrance on your [eyes'] rods and cones."

De Jong achieved confirmation by accident: when he rewound the video to watch it again, he saw instantly that the Great Dark Spot was a storm system rotating counterclockwise, a discovery that Ingersoll announced to the press the following morning.

Although De Jong calls the Venus videos "the best we've done out of this lab," he says the Solar System Visualization project is "still in the demonstration phase. We're still experimenting with how to use this kind of data visualization technique. With the next generation, we want to put a joystick in the scientist's hand and let him fly wherever he wants."



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WINGS OF THE GREAT WAR

Combat aircraft from World War I have an aura of romance and nostalgia—until you try flying them.

by Jeffrey L. Ethell

The sleek Albatros (left) was emblematic of German air power at its technological peak while the Allies looked comparatively inept (below). But the tide soon turned.

You can't practice flying a Fokker D.VII with an instructor aboard: single-seat World War I fighters don't have room for two. So there I was, about to make my first flight ever in a D.VII—and I'd be flying solo.

I had absorbed as much expert advice as I could before climbing into the cockpit. After starting the engine I tried taxiing out unaided, but with no brakes or steering I had to get people at each wingtip to help me. Once lined up, I reluctantly waved my wingwalkers away, glanced at the engine instruments, took a long look down the grass strip, and shoved the throttle forward.

The tail skid that had been such a hindrance during taxiing now bit into the ground and kept me pointed straight. Gaining speed, the D.VII tracked true and the tail came up quickly. Now I could see forward, but the nose began to swing to one side—engine torque—and it took full opposite rudder to keep the fighter heading straight. There was no margin for a crosswind, and I was reminded why old airfields were big square patches of grass: taking off directly into the wind was never a problem. The rumble of the wheels on the turf became intermittent as the Fokker neared flying speed, and I started to smile.

Big mistake.

JEFFREY L. ETHELL

My cheeks immediately filled with air. As a rule Fokker D.VIIs had no windshields; that's why pilots wore goggles. As the wind tried to ram its way down my throat, my head was forced backward. I pulled the stick back, got airborne, and strained to lean forward into the gale, whereupon my shoulder straps fell down

around my waist. I'd have to worry about that later; the first priority was to fly. I pulled the nose up to climb, and the airplane started to turn again in spite of full opposite rudder. With 180 horsepower up front, the propeller was creating powerful torque. My only option was to lower the nose and gain speed for increased rudder effectiveness, but that also made the slipstream stronger. I eased into level flight at slightly over 500 feet, reduced power, and picked up still more speed.

I looked down for my straps—wrong move. My goggles blew down around my neck and my eyes were flushed with air. Fokker pilots obviously had to look straight ahead if they didn't want their eyeballs blow-dried. I pulled the goggles back up and little specks of oil began to appear on the lenses. I could taste the engine oil on my lips and smell the exhaust billowing back past the cockpit. The vibration coming through the controls was turning my hands and feet numb. All five senses were overloaded and begging for relief. I was being dragged brutally back to the reality of what flying was like for those who fought in the Great War.

I got my straps back on and found I had to lean heavily into the wind to keep my head forward. Fokker pilots sat up fairly high so they could see enemy aircraft. I wasn't looking around much because the muscles in my back had started to cramp. After about 15 minutes I'd had all I could stand and headed back to land. The D.VII settled down onto the grass with a gentle rumble, and I let it roll to a stop.

My back and stomach felt as if they'd been pounded with a baseball bat, my hands and feet were tingling, I was partially deaf, I could taste the engine, my eyes felt like raisins, and my face was on fire from windburn. So much for any romantic notions of knights of the air. How could anybody survive in these things, much less fly them in combat and shoot down another aircraft?

When the war began in 1914, powered flight was just over 10 years old. Designers were still wrestling with issues like configuration, control surfaces, and engines with barely enough power to lift their own weight. Airplanes had top speeds of 60 to 80 mph, and their wire bracing created so much drag that they practically fell out of the sky when an engine quit.

At the outset of the war most pilots came from the horse cavalry. Cavalrymen were adventurous souls and thought to be fit enough to endure the new flying machines. Unfortunately, training horsemen to fly proved far more dangerous than anyone had imagined. Formal training with specialized instructors came late in the war, and more than half of all British Royal Flying Corps fatalities occurred during flight training. By early 1917 the average RFC pilot entered combat with around 15 hours of solo time. On his very first patrol, young Billy Bishop, who would later claim 72 victories, crashed while landing in his Nieuport.

RFC Cadet Officer Charles Illingworth felt lucky to get through. "Accidents in training were everyday occurrences and every training center had its funeral fund, deducted from the weekly mess bills," Illingworth recalled in *The Airmen's War, 1914-1918* (the source of many of the pilots' recollections quoted here). "I shudder to think

JON LYSTAD

Cole Palen, founder of a flying show and museum that showcase restored World War I airplanes in Rhinebeck, New York, looks the part. His weekend shows, which have run from spring through fall for 30 years, employ both original aircraft and replicas in carefully staged dogfights.

ANDY ANDERSON

CHRIS WELBON

Cockpits may have stayed low-tech (here, a Fokker D.VII's), but fighters like the S.E.5 (replicas, top) saw big performance gains.

of the wastage of young lives from carelessness or neglect.... I would complacently take into the air a fragile contraption of lath and piano wire, while the thought of reprimand on parade or a laugh at my expense in the mess would cause me acute distress."

During an especially deadly period in 1917 known as "Bloody April," a British pilot could expect to fly only 92 hours at the front before being killed or listed as missing. During that month, the RFC lost 316 airmen to the Germans, who were trained at a fighter transition school staffed by experienced fighter pilots.

In combat, both sides faced a physically debilitating environment. The engine and wind noise in an open-cockpit fighter averages 125 decibels, roughly equal to the noise of an air hammer. Temperatures often were below –40 degrees Fahrenheit at 20,000 feet, a height reached only after coaxing the machine upward for an hour. Returning pilots reported a vague malady they called "Flying Sickness D," unaware they were suffering from lack of oxygen. Human performance deteriorated, and at that altitude it could take 20 minutes to complete a simple task like removing a machine gun from its mount.

The pilots also had to cope with aircraft offering marginal performance. RFC pilot Corbett Wilson said that his first reconnaissance flight ended before it began due to "a fourteen stone [196 pound] observer, all tanks full, a rifle and ammunition and our heavy clothes and the ground was bad and I had to start downwind or rather down side wind while the machine declined to fly, tail went down and she settled down and flopped on one wing." Once airborne on a particularly ideal day, Wilson found it "took 50 minutes to do 20 miles coming home and that very low. At three thousand [feet] I was standing still."

Wilson's recollection only confirmed my own impressions after a first encounter with a 1915 Nieuport 10 powered by an 80-horsepower Le Rhône rotary engine. ("Rotary" means just that: the entire engine turns, cylinders and all, with the propeller bolted to the front of the crankcase; the crankshaft is fixed

to the airframe.) Cole Palen, the dean of all World War I restorers and fliers, owned this rare aircraft, a two-seat scout, and had gotten it into flying shape. The 10 was the first in a long line of famous Nieuport fighters, and it was in Palen's airframe that French ace Charles Nungesser scored several of his early kills.

Palen had picked a particularly cold fall morning at his Old Rhinebeck Aerodrome in New York in order to give the rotary engine and the wings the advantage of dense air. Bundled up in leather, I approached the machine with care. It is the oldest original aircraft in the world that's still flying.

After chocking the brakeless wheels, I climbed in around the wires and struts, slipping on a film of castor oil, which lubricates the engine. Palen primed each cylinder using a squirt can while I turned the gas valve on, pushed both throttle and mixture controls forward, then called "Contact." With one pull on the prop the Le Rhône sputtered to life, spraying castor oil all over the place, including the windshield and me. A quick reduction of throttle and mixture kept the tiny fighter from jumping the chocks, but there is no such thing as bringing the power back to idle. Instead there is a coupé, or cut-out button, on top of the stick. Press it down—"blip" it—and the entire ignition system shorts out, leaving nothing but whistling prop and cylinders. Release it and the engine roars back to life.

The technique is to use fuel and air controls to idle the engine below 1,200 rpm and use the cut-out switch above that. With the switch pressed, unburned fuel and oil fill the cylinders and spray into the horseshoe-shaped cowling. If you blip the engine for more than four or five seconds and then release the switch, you can start a fire.

The airplane rocked back and forth to the torque of a heavy engine up front. The Nieuport had no brakes or steering, so the tiny rudder alone had to control the expected swing on takeoff.

With Cole strapped in behind me, we called for chocks away, shoved the throttle and mixture controls forward, released the coupé, and bounced down the frost-covered grass. The swing to the left was marked, particularly for only 80 horsepower, but a quick application of right rudder on the slippery oil-coated rudder bar brought the nose back. The odor was overpowering—nothing smells quite like hot castor oil, which was pooling inside the cowling in immense amounts before streaming back along the fuselage.

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Though it had its quirks, the Fokker D.VII (above and facing, top) was easier to fly than its predecessors. It came too late in the war to help Germany, but many regard it as the best combat airplane of the period and certainly superior to the touchy and notorious Fokker Dr.I (replica, right).

In only a few hundred feet the airplane was airborne. Although the Nieuport is blessed with ailerons instead of wing warping, engine-propeller forces were so strong that both the stick and rudder had to be pushed far right to maintain control. I could imagine a student pilot in 1915 stalling and spinning into the ground with no idea of what was happening—it had been a common enough fatal accident in training. A rotary at full power in a spin could add such force to the descent that pilots dug smoking holes in the ground with these little machines.

Leveling out at 500 feet with frigid air pouring into the cockpit and castor oil congealing on everything, I settled into a cruise at 70 mph. The factory quoted a top speed of 87 mph, but I doubt that was achieved very often. The stick and rudder had to be held to the right to fly straight ahead. To turn to the left I simply centered the controls and around she went. I had the seat-of-the-pants feeling that any more input to the left would have put the biplane on its back in a hurry. A right turn gave me the impression of minimal control so I dropped the nose to gain some speed. Though the airplane coped, it shuddered its disapproval.

Early in the war, dogfights had to be waged carefully because the airplanes would spin out of control so easily. Manfred von Richthofen, who would later become known as the Red Baron, remarked that he was not much good at maneuvering; he preferred a surprise slashing attack.

We turned back to Old Rhinebeck, and I reduced throttle and mixture for descent. As I turned for final approach I had to use the cut-out switch repeatedly to reduce the power. *BrrrUP...whooosh...brrrUP...whooosh...*all the way down until we settled gently on the grass. With the last bit of speed, I applied full rudder to turn us 180 degrees and taxied back using the cut-out switch, rocking the wings with every *brrrrUP.* Covered with oil, I climbed out after Cole. (Hours of inhaling castor oil had a predictable effect on ser-

vice pilots' bowels, but a good dose of milk laced with brandy usually counteracted it.)

As U.S. Air Service Lieutenant Douglas Campbell recounted, "I think most of us, having been cast at an early age into what, up to then, was undoubtedly the most exciting adventure of all time, regarded it as exactly that, and the future was nonexistent. We had the best aircraft and equipment there were at the time, we thought.... True, we were lucky if the engine did more than about 50 hours before overhaul, and overhauled engines were not considered good enough to be used in combat aircraft, but we had been trained always to be on the lookout for a likely-appearing cow pasture in case we suddenly needed it, so what?"

By the middle of the war, both sides were scrambling to improve their aircraft. Designers turned out machines at a furious rate. Engines soon developed more than 160 horsepower, and the airframes incorporated advances in controls and increased armament.

This was most evident to me as the German Pfalz D.III biplane (Doppeldecker) was rolled out of the Fighting Air Command hangar at Hartlee, Texas. Though coming only a year and a half after the Nieuport 10, its developmental leap was

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striking. Not only were the engine and airframe bigger, with enlarged control surfaces, but the smooth plywood stressed-monocoque fuselage left fabric-covered frames behind. There were still no brakes, but its tail skid was steerable—a major improvement for ground handling.

After some advice from FAC pilot Randy Wilson, I climbed up some flush built-in steps and settled into the cockpit. I had an immediate sense of security. The fighter was well braced all around, and although the top wing limits visibility, with a little stretch I could see over it. After the engine warmed up, I waved for the chocks to be pulled and taxied to the runway, this time without wingwalkers.

Even with full power, the Pfalz accelerated slowly. Horsepower had increased, but designers had increased weight proportionally. The steerable skid, large rudder, and long fuselage virtually eliminated the effect of torque, a wonderful relief. With slight back stick the Pfalz lumbered into the air, climbing very slowly. Leveling off at 800 feet, I let the speed build up and felt thankful for the windshield.

The first turn revealed the compromises inherent in the Pfalz. Though it

The SPAD models VII and XIII, France's answer to Germany's Albatros and a trend to more powerful engines, mounted a 150-horsepower Hispano-Suiza, and U.S. ace Edward Vernon Rickenbacker (right) "could dive away from any of the German planes like a streamlined brick," in Anthony Fokker's words.

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was rugged, the fighter, like the very similar Albatros D.III and D.V, was disappointing to pilots who wanted a high rate of roll. When I applied aileron the Pfalz had to make up its mind before it responded. Trying to outmaneuver an agile Sopwith Camel would have been unwise.

After climbing above 2,000 feet, which took far longer than I would have thought, I put the Pfalz into a dive and found its heart—it comes down as if on rails, one of the few wartime fighters that did not break up at high speeds. The controls felt as if they were locked in concrete, but I could see that the D.III's reputation for making slashing attacks against Allied formations was well earned. As a gun platform it was very stable—too stable for a dogfight but ideal for a long burst at an unsuspecting target. Visibility over the wing on the way down was superb, a characteristic that made it useful as a specialized balloon buster.

A man would have to be very strong to wrestle this fighter around the sky. I needed both hands just to get the Pfalz around a tight circle. Back in the landing pattern I could sense the need to keep power on all the way to touchdown; power off, it must have been a brick. Moderate rudder control held the D.III straight, and my only scare was a strong gust of wind that threw a

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French Nieuports (here a replica of a model 28, which entered service in 1918) made up for Britain's shortages early in the war.

wing down and pointed me toward the bushes. A quick burst of power coupled with some of that big rudder and I was tracking straight again.

The Pfalz D.III and D.IIIa, though far outclassed by the end of 1917, were produced until the war's end in order to fill the ranks of Germany's fighter units. After Bloody April the tables turned in favor of the allies as Germany was forced to field as many machines as it could but with less experienced aircrew. The docile though heavy Pfalz was relatively easy for a novice to fly, but the compromise didn't pan out.

Though the war pressed designers to make improvements in the airplanes, the results were mixed. Anthony Fokker, a Dutch aviation pioneer who never seemed to gain the acceptance of his German contemporaries, was especially sensitive to the pressure. "From the first," said Fokker, "I made it my business to lend a ready ear to what pilots said of every plane they flew or fought against.... By heeding their complaints and requests I often knew what the next improvement must be two or three months before the urge took official form....

"As fast as one side appeared at the front with a superior plane, efforts doubled on the other to equal or better it.... Thus the temporary advantage drifted back and forth across the lines, with the manufacturers almost as deeply embroiled in the fighting as the combat pilots themselves."

When the Sopwith Triplane appeared, Fokker turned to his chief designer, Reinhold Platz, and urged him to come up with something better. Sizing up the Sopwith's advantage, Fokker knew "greater power was for the moment unavailable. It was up to me to make a compromise with reality, retaining only the absolute essentials of a fighting ship. My theory was that the ultimate test of victory occurred in five or ten minutes when German 'circus' and Allied squadron met in a dog-fight. Therefore I sacrificed speed for climb and maneuverability, and the Fokker triplane was the result.... The Spads of the French were faster, and could dive away from any of the German planes like a streamlined brick. But they were not as fast on turns or as speedy in climb."

Of all the fighters in the Great War, the Fokker Dr.I Triplane (Dreidecker), the airplane Fokker unveiled in late 1917, was the most controversial. In the right hands it sparkled during a dogfight, but it had a poor top speed and terrible handling characteristics. Unstable in all axes, constant control input was needed to keep it from doing something hideous. This could be terrifying to an inexperienced pilot because the airplane almost had a mind of its own. Yet this very trait is what made it sing in the hands of von Richthofen, who made the airplane a legend and kept flying it even after newer aircraft had surpassed it.

All in all, I wasn't feeling particularly elated when I faced my first flight in Randy Wilson's Dr.I at Hartlee. As I stood next to the aircraft I was surprised at how small it is, although I shouldn't have been. Fokker's power was limited to a 110-horsepower Oberursel or Le Rhône rotary, so he had to design what would later be called a lightweight fighter, sacrificing top speed to gain maneuverability. Trying to ignore all the horror stories I had heard, I concentrated on Randy's few words of instruction and mounted up—literally. You put one leg into the stirrup-like step, then swing the other leg over the rear decking and into the cockpit.

Once seated, with my head positioned high above the fuselage, my view forward was blocked by three wings, the big, round cowling, and the extreme nose-up attitude created by the short fuselage. I had to work to hold my head forward and there wasn't even any slipstream yet. I started the engine and the airplane waddled toward the runway. If I crouched down, I could see forward just a little through some cutouts in the middle wings, which had been put there for that purpose.

Lined up for takeoff, I couldn't see the runway ahead of me though I could watch both sides. This first takeoff, with no time at all in the machine and no one aboard to help, not even a radio, would have to be made on past flying experience alone. I added power slowly.

Much to my surprise, before I had applied full power the tail popped up and—second surprise—I got excellent rudder control from that small, com-

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Punished by winds, freezing temperatures, thin air, noise, and engine fumes, crewmen of the 11th Aero Squadron, Day Bombardment coped as well as they could by piling on woolens and leathers. The Sopwith Camel (Cole Palen's replica shown opposite) got high marks for agility.

ma-shaped fixture atop the tail. Visibility was immediately excellent, the presence of three wings almost unnoticeable. The airplane bounced and hopped straight into the air before I could worry about how horrible all this was supposed to be. Three wings may produce abominable drag, but wow, do they lift! The climb rate was astonishing in spite of an almost flat, nose-level attitude. I was at 2,000 feet without much fuss.

After I leveled out, the nose no longer blocked my view. What visibility! Perched high on the seat, I could easily scan the sky for aircraft. The two Spandau machine guns sat directly in front of me, easy to aim and accessible when jammed.

With more speed, I discovered that the rudder has almost no feel to it. When I pushed on the rudder bar, I got none of the expected feedback pressure in my feet. The wind on the sides of my face would have to do for input.

My first turn was an education. The wings generate so much lift that just a touch of aileron produces an immediate change in heading. Not only was normal coordinated use of the rudder in the turn unnecessary, but I actually had to hold some opposite rudder to keep the airplane from rolling over on its back. The ailerons were extremely stiff, giving a very poor roll rate, but that was not much of a liability because rudder and lift made up for it.

Working up some courage, I decided to try a tight turn. Racking the Fokker over onto its side, I pulled back on the stick and whipped around immediately, feeding in a large dose of "top" rudder to keep the nose up. Combat pilots agreed that virtually nothing could outturn the Dr.I, though the Sopwith Camel came close. My blurred eyes and sagging goggles confirmed the assessment. Daring the fates, I dropped the nose to get some speed and pulled back for a loop—zap, over it went, almost as if it were trying to bite its own tail. Over the top, engine torque overcame full opposite rudder and my fighter flopped over on its side. On my next try I kept the loop tight and she went around instantly. If a German pilot wasn't careful, no doubt he could loop or turn and still be in front of his opponent.

Releasing the stick and rudders produced an immediate, violent sideslip followed by a rapid pitch-up of the nose. If I hadn't recovered immediately the aircraft would have entered a violent spin. Taking advantage of this appalling quirk, pilots found that one of the more effective maneuvers in combat was a wings-level flat turn using rudder alone. The speed would bleed from 100 mph to 60 mph after 180 degrees, but Allied fighters fell out of the air trying to follow it. Though the Dr.I is occasionally terrifying, of all the World War I types I have flown it is by far the most thrilling.

It is also, hands down, the most frightening to land. Once the tail drops, rud-

der effectiveness disappears completely. Ax-handle skids were bolted under the airplanes' bottom wingtips after pilots continued to bust their machines up in one ground loop after another. Complete loss of control on landing was not unusual.

I found the best thing to do was fly all the way onto the grass and, when speed began to die down, pull the stick back to keep the tail down and the tracking straight. Heaven help anyone who bounces on touchdown, for at that low speed all controls are ineffective and the airplane will surely roll itself up into a ball. In a sideslip close to the ground, you can actually stall the rudder out completely and end up descending into the ground at full power, unable to regain control.

Werner Voss, one of the masters of the Triplane, ran up 21 of his kills in almost as many days. On September 23, 1917, RFC pilot James McCudden was leading a flight of S.E.5's when he spotted Voss' silver-blue Triplane patrolling alone. "The German pilot saw us and turned in a most disconcertingly quick manner, not a climbing nor Immelmann turn, but a sort of flat half spin," McCudden later recalled. "By now the German triplane was in the middle of our formation, and its handling was wonderful to behold. The pilot seemed to be firing at all of us simultaneously, and although I got behind him a second time, I could hardly stay there for a second. His movements were so quick and uncertain that none of us could hold him in sight at all for any decisive time..."

Running in on the Fokker several times, McCudden saw "the triplane...still circling around in the midst of six S.E.'s, who were all firing at it as opportunity offered, and at one time I noted the triplane in the apex of tracer bullets from at least five machines simultaneously, and each machine had two guns." Apparently running out of fuel or stamina, Voss was finally engaged by Lieutenant A.P.F. Rhys-Davids and killed. McCudden was deeply affected by the event: "As long as I live I shall never forget my admiration for that German pilot," he wrote. "His flying was wonderful, his courage magnificent, and in my opinion he is the bravest German airman who it has been my privilege to see fight."

Regarded as the finest fighter of the war, the Fokker D.VII arrived at the front in April 1918, a few days after von Richthofen was killed and only seven months before the end of the war. With the D.VII, the airplane had come into its own as a weapon. Because it was easier to fly, the inexperienced pilot had more time to concentrate on employing his weapons. The D.VII was also an excellent compromise. Though underpowered by today's standards, the angular fighter had a good power-to-weight ratio and excellent maneuverability at high altitude.

On my second flight in it I was at least resigned to the wind blast. In order to get the tail around while taxiing I had to move the stick forward, give a blast of engine, then kick rudder. This hop-and-skip method is fine as long as engine torque doesn't come into play. A prolonged blast will produce so much swing from torque that the tiny rudder can't cope. I found myself making one 360-degree circle after another, going nowhere until the wingwalkers came out to help. During the war the mechanics simply wheeled the aircraft out and chocked them facing into the wind. After warmup the chocks were pulled and off the pilot went without a worry.

Once in the air the D.VII is very easy to maneuver and has no bad habits. Controls are solid and effective but not excessively stiff, as in the earlier designs. Sharp turns have to be led with some top rudder, but it's nothing like the Triplane. It is very stable in a dive, almost comfortable, except for that wind. The weight and design that lend it such stability also give it a high sink rate with the engine at idle.

The D.VII lands beautifully, with little tendency to bounce, tracking true until the last few yards, when it tends to drift left slightly. For a new fighter pilot in 1918 this must have been a tremendous comfort after training on marginal machines.

Each time I walk away from a World War I fighter, suffering from the prolonged effects of cold, wind blast, numb appendages, hearing loss, aching muscles, dry eyes, carbon monoxide poisoning, general exhaustion—and this after only 20 minutes of flying—I feel genuinely alive, even elated. These airplanes, unlike their modern equivalents, challenge me. I can't help but wonder what their original pilots thought when they pulled off their goggles and climbed down from the cockpit, weary at the end of a flight. More than anything else, they must have been thankful just to have survived.

FRANK MORMINO

FATE WAS THE

HUNTER

Ernest K. Gann's account of life as an airline pilot was hailed by many as a definitive work. Thirty years later, how much of it still rings true?

by Jerry Slocum

Recently, I had occasion to renew an old friendship, and, as people often do in such situations, to wonder at the changes wrought by the passage of time. Not a friendship with a person but with a book: *Fate Is the Hunter* by Ernest K. Gann. I came across my copy, dog-eared and much traveled, packed away in a box, and realized it had been more than a decade since I'd last read it. *Fate* recounts Gann's career as an airline pilot, and it played a major role in my life, the way books can when read at a receptive time. It helped me decide to become a professional pilot.

ILLUSTRATIONS BY PHIL JORDAN

This year marks the 30th anniversary of *Fate*'s publication, and in many ways the book shows its age: Gann's era was, after all, DC-3s, while mine is jets. Nevertheless, I still regard *Fate Is the Hunter* as the best book ever written about airline flying. Gann is the master of taking the bones of piloting's most cherished clichés—courage and cowardice, camaraderie and loneliness—and putting flesh on them, evoking the human faces in what otherwise would be just expanded logbook entries. He is particularly attuned to the mysteries of man's struggle to master technology, and how that struggle seems influenced as much by fate as by cause and effect. It is the drama of pagan superstition played against the laws of science and engineering that makes the book, for me, timeless.

But as I re-read it, this time from the perspective of a pilot with close to 10 years' experience flying for the airlines, I was struck more by the contrasts between Gann's career and my own, and by the transformations the industry itself has undergone in the ensuing years.

The book begins in 1938, when Gann, with 1,100 hours of experience barnstorming in biplanes, was hired by American Airlines. For that era his flight time was unusual—most of his classmates had less—and for American's purposes the experience compensated for his lack of an instrument rating. These days Gann's qualifications wouldn't get him past the front door of even the smallest commuter airline, much less a major carrier like American. Now new hires have more like 3,000 hours of flying time; biplane time counts for little, and an instrument rating is mandatory.

Gann began his airline career as a copilot on DC-2s and DC-3s. Sixteen months later he made captain (extraordinarily swift progress by today's standards). When World War II broke out he was swept up, along with many of his contemporaries, into what became the Air Transport Command, flying various four-engine transports to Europe, Africa, and the Far East in support of the war effort. Following the war, Gann returned to American, where he found himself oppressed by the "accursed numbers" of the pilot seniority list, which relegated him, in spite of his thousands of hours of four-engine, over-ocean command experience, to the DC-3, plodding along the same domestic routes he'd flown as a copilot.

Gann finally quit, largely because of the numbers. A colleague at American, number one on the seniority list at the time, relinquished this wondrous digit to become chief pilot for a new airline, and Gann followed him eagerly. At first it looked like a good move, but Matson Airlines (the steamship line's attempt to break Pan Am's Pacific monopoly) was eventually denied its franchise, and Gann, having burned his bridges to American, ended up on aviation's fringes, once again a copilot, flying for a hand-to-mouth charter airline. After a few, often discouraging years, Gann finally retired as an airline pilot in the mid-1950s.

But by then he was also an established writer, with a number of novels to his credit. While not always well received by the critics (one characterized his fiction as "of the formula school of novel—the Novel of Precarious Situation"), these adventure tales, drawing on Gann's flying experience (*The High and the Mighty*, for example) and his passion for sailing ships, gained an avid readership. Freed from the airlines, Gann began a work of nonfiction, combining his many

COURTESY ERNEST K. GANN

Seated here in a Bücker Jungmann, Ernest Gann logged over 20,000 hours of flying time before penning his classic.

notes, character sketches, and memories with his musings about fate's mysterious purposes. The result, *Fate Is the Hunter*, was an immediate success. Critics hailed it for the emotional authenticity they had sometimes found lacking in Gann's novels, and the public's enthusiasm propelled it onto the best seller lists. In the 30 years since, the book has never once gone out of print.

Some of the differences between *Fate*'s era and mine are apparent from the first chapters, which detail Gann's apprenticeship as a copilot. In his time, the copilot did most of the flight planning and all of the paperwork (both today are done mostly by computers), loaded and unloaded baggage and cargo (not in my job description, thank you very much), and served as "janitor of the sky," responsible for, among other things, keeping the DC-3's quarrelsome heating system working properly (on today's jets, fully automated).

For all that, the status Gann and his fellow copilots enjoyed was roughly equivalent to that of a Hindu untouchable. The captains they flew with sometimes went out of their way to make their copilots' lives miserable, ignoring them on the ground and refusing to allow them to try a takeoff or landing for months at a time. Today, Cockpit Resource Management is the vogue, using terminology straight out of an MBA thesis to state what for many of us has always been obvious: crew members need to communicate clearly and treat one another with respect.

More amazing to me are some of the practices Gann describes as routine. Pilots would conduct lengthy and complex procedures from memory, instead of relying on written checklists, as we do now. Confronted with a thunderstorm, they would grit their teeth and fly right through it, whereas today we would retreat to our alternate airport and make no bones about it. And wildest of all, if they got caught in bad weather and a regular instrument approach to the airport wasn't available, they would improvise an approach, searching for a runway by following railroad tracks or roads down to within a few hundred feet of the ground. Small wonder fate often took them to task. (Gann begins the book with a long list of "old comrades" who were killed flying for the airlines; the rest of the book, with its almost continuous string of perilously close calls, reads like aviation's ultimate cautionary tale.)

Still, many of his observations of the profession hold up even in the Jet Age. The seniority numbers are still affixed

Trainee in the Hot Seat

[A]s we start the turn for the final descent, which is always the most complicated and demanding in accuracy, Ross [the pilot] takes a box of matches from his pocket and lights them one after another just under my nose. I gasp a protest. I am heavily engaged in trying to hold course and altitude exactly according to the book....

"What the hell are you doing?"

I am bewildered. If I were not so extremely busy I would brush the flame away. It is difficult to see the instruments beyond the flame, and Ross holds it just close enough to make breathing difficult.

I blow out the match. Ross at once lights another. I am fifty feet too low, the compass is swinging in a direction it should not, and my speed is falling off.

"Steady..."

Ross's voice is calm and without malice or mischief. Then what in God's name is he up to? The performance, on which I was just about to congratulate myself, is rapidly going to pieces.

I fight to keep things in order, not because we are in the slightest danger at this altitude, but only because Ross has deliberately

ruined what might have been a technically perfect approach. For this I cannot forgive him.

As one match after another flares before my eyes I become infuriated with Ross. He is a sadist, sick with weird complexities. He is afraid I *will* do a good job. To hell with him! I will keep everything as it should be regardless of his jealous interference.

Sweating profusely, inwardly cursing Ross's twisted sense of humor, I resolve to fly this ship safely and surely to earth in spite of any harassment. I force myself to ignore Ross's match, to see beyond it to the instruments.

As we turn in for the final descent I shove the propeller controls to full low pitch. We are exactly at required altitude, the speed is right, and also the course.

Ross shakes out his match and sits back in his seat. I glance at him, my resentment doubling when I discover him smiling. We will have this out on the ground!...

I call for full flaps, chop off the power, and we swoop down through the light rain until the wheels brush the cinders....

When the engines are stopped I complete the logbook in wounded silence. Ross leaves his seat and puts on his coat. It is raining harder outside. Maybe his ridiculous cap will shrink to the size of his brain.

I snap the logbook shut and am about to stand up when I feel his heavy hand on my shoulder. My grip on the metal logbook tightens. If he tries one of his playful swings—

But his voice is surprisingly tired and so is his smile. "Anyone can do the job when things are going right. In this business we play for keeps."

Storming the Taj Mahal

It had been a remarkable journey in three ways: the first because the sole cargo was millions in Chinese paper money, the second because the flight circled half the world and the co-pilot had proven himself to be the only living human being who could never be taught to fly, and the third because it had almost made me a person of dubious historical fame. I had nearly destroyed one of the seven wonders of the world....

We are halfway down the runway and have only achieved sixty miles an hour. I glance quickly all around—at the instruments, the engines, and the remainder of the runway.... What the hell is wrong now? Even this C-87 has never behaved in such a leisurely fashion.

Yet all is apparently in order. These are the moments of truth in a pilot's life when he must decide within seconds whether he should abandon take-off and jump the brakes or fully commit his airplane to flight. There is still room for choice. Finding nothing amiss, I hold forward....

Eighty miles an hour. We need one hundred and twenty and I should prefer one hundred and thirty. The trees dance toward us,

wavering in the sun. Ninety. The choice is gone, other than a certain plunging through the trees.

One hundred. I haul back tentatively on the elevator controls seeking response. Very mushy....

One hundred and ten at last. I can raise the nose wheel a little, but not yet enough.... I haul back on the controls. The C-87 leaves the ground, sinks back, bounces on one wheel, then staggers aloft in a mushing half stall.... We are for an instant in the clear, over the river. Full power. Air speed one hundred and thirty and still sinking.

Now, a new obstruction, dead ahead. The Taj Mahal. They are making repairs. Much of it is covered with scaffolding and I can see the workmen moving about. I can see the folds in their turbans. I can see their mouths open as we approach. I cannot see any beauty....

There is one crazy hope. It is not written in any book of aerodynamics. Park told me about it long ago. But I have never tried it, nor has anyone else on a C-87.

"Franko! Full flaps!"

He slams down the lever. The C-87 collides with a soft invisible wall. The air speed falls off and everything shudders. But we balloon upward a hundred feet almost instantly—barely enough to clear the spike of the first minaret.

"Now ease them up slowly!"

Franko complies and we sink again. But speed is returning. And I think we can clear the next minaret without turning. It flashes past. I see a group of workmen cringe against the scaffolding. The Taj Mahal is gone. We swoop down beyond it and with agonized slowness begin picking up enough speed for a halting climb.

like prisoners' tattoos on each pilot's destiny, dictating everything from professional advancement and retirement benefits to weekend and holiday flight schedules, crack-of-dawn reporting times, and layovers in the boondocks. Whether the pilot is experienced or a novitiate, bold or meek, "good stick" or technician, possessing the right stuff or the wrong—all this, in light of the numbers, is irrelevant.

Gann's characterizations of pilots as a breed also continue to ring true. We still cannot resist watching an airplane take off or land, we still discuss our flying abilities with an almost comically exaggerated modesty, and we still tend to shy away from lengthy contact with passengers.

But we're less clannish today, perhaps because there are so many more of us, while the differences among airlines are diminishing. And it's my impression that Cockpit Resource Management, though improving crew coordination and thus overall safety, also seems to be hastening the retirement of a great many of the colorful characters—both the "notorious taskmaster" type described in *Fate* and the more companionable variety—who were more the norm in Gann's time.

Gann describes the pilots of his era as being "in love...bewitched, gripped solidly in a passion few other callings could generate." Though many pilots today feel the same way, they are more likely to affect cool professionalism, keeping any romantic notions about their work deep within their heart of hearts. And unfortunately, it's also true that some of those in airline cockpits these days consider flying merely a job, a steady paycheck. Characterized mainly by an inability to say anything nice about their profession, these pilots seem, inexplicably, to be increasing in number.

Maybe the shift in attitude has something to do with the changing role of fate. Which raises the question: Is it still the hunter? Given the sense Gann implies—that fate often singles pilots out for special attention because of what they do—I think the answer is no. Airline flying is so much safer today that fate seems to have been reduced to the joker in the deck.

But never mind. Clearly, it seemed otherwise in Gann's time, and the fact that he remained alert, took notes, and survived to tell the tale is the important thing. My only regret is that Gann didn't stick with the airlines long enough to take part in their introduction to jets. Assuming his luck held, of course, it would have made for one hell of a sequel.

DRIVEN BY

It takes a rare breed of pilot to fly a thousand miles without an engine.

By Peter Garrison

Illustrations by Paul Salmon

Tom Knauff awoke with the west wind in his ears. He lay in the darkness listening to it, sorting out its blurred voices, estimating their meaning: a steady nearby hiss, a more distant howl, the thud of a gust stumbling like a drunken man against the side of the house.

He propped himself on his elbow and turned to the luminous dial. It was 3:30 in the morning. "Doris," he said.

The wind was not supposed to have come. Not yet. More rain, the weather report had said. Last night Knauff and Doris Grove had gone to a play, dined with friends, and come home after midnight. The wind was not supposed to have come...but there it was.

In a few minutes they were driving to the airport. Others soon arrived, and like soldiers readying for a raid at dawn they worked rapidly in the darkness, their boots grating on gravel or squelching on the spongy earth, their words, clipped with suppressed excitement, seeming to peel from their lips and fly off on the steady harsh wind. Small snowflakes flurried around them. In the glare of automobile headlights they pieced together each of the Nimbus 3's 40-foot wings, slid them into their sockets in the fuselage, clicked the locking pins home, snapped and locked the horizontal tailplane into place atop the fin. The cold bit deeply if one stood still for long—but no one stood still.

The sky, gray-peach in the east, began to outline the ridge and the ragged shelves of cloud that clung to it. It took nearly an hour to fill the ballast tanks in the wings with 80 gallons of water and antifreeze, to complete the required paperwork, to haul the 1,700-pound glider out to the runway and hook it up to the towplane. The wind moaned unabated.

A little after 7 a.m. Knauff was airborne behind the towplane, heading northeast toward the starting point of the ridge. Low ceilings and snow showers pushed them down to 700 feet. The tow pilot wanted to turn back; Knauff offered him an opportunity to look for a new job. After 40 minutes, over the town of Williamsport, Pennsylvania, Knauff released the towrope and banked back to the south and west, sidling up to the shoulder of the nearby ridge.

He knew it would be a good day—a great day. He overtook and passed the towplane. As he sailed by his home airport, where other sailplanes now waited helter-skelter on the grass, he was doing 140 mph.

When he returned to Williamsport ten and a half hours later on that April 1983 day he had flown farther than anyone had ever flown in a sailplane: 1,023 miles on the power of the wind alone. The record still stands. Knauff had surpassed his friend Karl Striedieck's world record, set six years earlier along the same route, by only seven miles. But his speed, an unforgettable memento of the wind's strength that day, enabled him to beat Striedieck's time by three and one-half hours. Knauff had averaged an unheard-of 96 mph.

Striedieck didn't fly that day. Gulled by the pessimistic weather reports into

THE WIND

an uncharacteristic lapse of vigilance, he had slept in.

Lean, weathered, with a hunter's sun-darkened skin and the undulating nose of a boxer, Karl Striedieck is a man thoroughly at home in the sky. After serving as a fighter pilot in the Air Force a few decades ago, he flew 707s overseas for Pan Am. But airline flying was too dull for him; he quit after two years and returned to his birthplace in central Pennsylvania to fly F-102 Delta Daggers for the Air National Guard and gliders for recreation.

Striedieck's interest in gliding was born of a love of hawks. As a teenager, he had visited Hawk Mountain Sanctuary in eastern Pennsylvania. "The sight of hundreds of hawks sailing effortlessly down the invisible cushion of air captured my fancy, and I longed for a way to join them," he wrote in an article for *Soaring* magazine titled "Confessions of a Pennsylvania Ridge Runner." In 1965 he founded, with Tom Knauff, the Nittany Glider Club in State College, Pennsylvania. Three years later he set his first world record for out-and-return distance: 477 miles.

It was around then that he also bought 260 acres atop part of the very ridge along which he and Knauff were flying to their records. There Striedieck raises golden eagle chicks from a local zoo for release into the wild. He aims to establish a breeding population of the birds in his home state, and every autumn he spies on their migrations from a fire tower on his property.

Like all top glider pilots, both Striedieck and Knauff possess the gene of intense competitiveness that enables them to think of one thing and one thing only for up to 14 hours of grueling and often hazardous flying. They have the self-confidence, or easy reliance on luck, to take risks, as well as the uncommon skills to make the risks turn out well. Both possess a kind of forbidding cragginess, Striedieck's superficial, Knauff's deeply hidden. But all those qualities are so wrapped up in others that one could hardly ask for two men who are, at first acquaintance, more different.

Tom Knauff is the more sociable. A hard-working entrepreneur with a bustling mail order sales business and a 16-hour-a-day job running his gliderport, Knauff spends his days surrounded by pilots, talking and joking, giving advice, venturing opinions—notoriously optimistic—on the next day's flying conditions, enlisting gangs of idle fliers to sand a wing or paint a building.

Striedieck, on the other hand, is still in many ways the teenage boy in love with hawks. He has a boy's flashes of unconscious arrogance and egotism, the uncorroded romanticism, impulsiveness, and innocence, and the sometimes hostile demeanor that shelters a

companionable, talkative soul. Recently divorced and with no children, he treasures his freedom. "It's given me a lot of flexibility in my life, not having kids," he says, expounding his philosophy with a terse "I want to do it *now*."

It was on his Guard flights in the wasp-waisted delta-wing interceptors that Striedieck first started thinking about the ridge.

The Appalachian mountains are the feeble remnant of a rampart that once rose, according to geologists, higher than the Himalayas. Now they are no more than a few ripples, old folds and wrinkles running in a lazy serpentine from the Gulf of St. Lawrence in Canada down to central Alabama. What makes them valuable to sailplane pilots is that their westernmost ridge, called Bald Eagle, rises cleanly out of the gently rolling Appalachian Plateau and lies athwart the northwesterly storm winds of spring and fall. Winds pouring across the long, level reaches to the west fetch up against that first sharp ridge; they blow through woods of larch and maple, up the steepening slope to the crest a thousand feet above the plain, and then tumble into the valley beyond.

From his vantage point eight miles up Striedieck could follow the ridge with his eyes. Crisply outlined by the cool shadows of morning, it ran almost unbroken, as if saw-cut, curving gently through Pennsylvania and fading beyond the horizon into the blue mists of Kentucky and Tennessee. To Striedieck's eye, air was as visible as water; he could see the blue wind flood down from Indiana and Ohio and break against that ridge. And he could see himself down there, a sleek white cross against the ridge, racing south to a world's record.

Pilots come to the ridge from all over the world for a week or two at a time, hoping to hook the strong day of dreams

TOM KNAUFF

and make the 500-kilometer (310.7-mile) flights that will win them one of the Soaring Society of America's Diamond Badges. For ridge addicts, the names of places along it—the Knobblies and Bedford Gap, Seneca Rock, Tazwell and Covington—are imbued with emotion: elation, fear, hope, discouragement. There is even a book, written by Knauff, describing virtually every ripple, rock, and rivulet of the ridge, discussing the gaps and weak places and emergency landing fields, prescribing the altitude needed to traverse a poor spot in weak conditions—a topological love poem to the Bald Eagle Ridge.

The sailplanes fly along the western side of the crest, 50 feet from the trees, maintaining their altitude by falling continually in rising air. On a strong day, when the wind is coming at close to 30 mph out of the northwest, a scrap of paper would ascend 1,000 feet a minute; a clean sailplane converts that uplift into forward speed, coasting along the ridge that sweeps past in a steady brown blur, bending with it, rising and falling with it, tacking southward on the wind's gift of power in a temporary illusion of eternal flight.

The ride is rough that close to the ground. Striedieck says it's the nearest thing he knows to flying a low-level jet fighter mission. The mountain gives its shape to the wind, and every gorge and knob becomes a gust or eddy that slams the racing sailplane, thudding the pilot down into his seat or up against the canopy. Pilots wear foam rubber pads on their heads; a few have broken their canopies with their crowns.

To maintain concentration for hour after hour of punishing flying requires an unusual kind of determination and mental firmness. But even in pleasant conditions, flying for such long periods is hard work. "I have a problem with being distracted very easily," Knauff confesses. "I'll be flying up there and all of a sudden I'll notice a bird or some pretty little pattern on the earth or in the clouds. I have a terrible time concentrating on the task at hand."

What exactly is the task, this hiking and hopping on invisible terrains? "It's a great big Nintendo game," laughs Striedieck. But his meaning is serious: the skill is something deep and intuitive, like a sense of direction, developed over years of flying up and down the ridge and becoming intimate with all its anfractuosities. The mental state the great pilots cultivate is more like meditation than thought.

There are other ways to fly great distances in a sailplane besides hugging the windward shoulder of a ridge, as Knauff and Striedieck do. Another, paradoxically, is to fly on the lee—the downwind—side of mountains, where strong winds sometimes set up condi-

tions called waves. A third possibility is to use thermal lift, gaining altitude by hopping from one column of rising sun-heated air to another.

Waves are undulations that appear in the wake of a large obstruction, such as a mountain peak or range, when a strong wind blows. They may extend hundreds of miles downwind, their humps and troughs stationary, with smooth lens-shaped clouds called lenticulars sometimes resting like alabaster domes upon each hump.

Flying in mountain waves is quite different from ridge soaring. Rather than hug the terrain, the wave pilot looks for telltale configurations of mountain and cloud and, once he finds the wave, rides up toward the tropopause, often climbing as fast as an express elevator on air of a glassy, uncanny smoothness. Waves have carried gliders to the extreme altitudes reached by jet airliners: the world's record, set by Robert Harris in 1986, is 49,009 feet.

Waves are never continuous along a mountain range; there are lateral gaps between them, and each wave alternates longitudinally between lift and sink. To fly long distances on waves, therefore, pilots must jog and sidestep, accepting stretches of alarming sink between the islands of glassy lift. They must know the characteristics of a mountain range, the likely locations of lift, the exact anatomy of forming and fading lenticulars and of the murderously turbulent "rotors" that sometimes lie below them. They leapfrog, then, from wave to wave, climbing one wave to heights of several miles before speeding across a gulf to the next.

In December 1990, a New Zealand pilot named Ray Lynskey rode waves to a new longest-flight-ever. But his flight does not qualify for an official record because it did not follow any of the conventional out-and-return, triangular, and quadrangular patterns for which records are recognized. Lynskey took off at 6 a.m. from Woodbourne airport at Blenheim, on the south side of the strait separating the north and south islands. Climbing to 20,000 feet in the lee wave, he flew almost to the tip of South Island, turned around, returned to the strait, and crossed it—a distance of a hundred miles without lift—then flew halfway up North Island to where its mountain backbone sinks into a plain. On the northern leg he climbed above 28,000 feet; then he turned and retraced his path, crossing the strait again to land at Woodbourne at 9 p.m. He had been airborne for 15 hours and had flown a total of 1,256 miles.

Lynskey has flown sailplanes since 1974. He possesses the same combination of piloting skill and deep knowledge of a certain piece of terrain and a certain kind of weather that makes Knauff and Striedieck masters of the Bald Eagle Ridge. He is on a first-name basis with each mountain and the clouds that are its companions; he reads their lights and shadows, their hints of puff and raggedness, the way an animal tamer reads the moods of lions in the twitching of their ears and jowls.

MIKE KOERNER

Lynskey professes not to care that his flight qualified for no record and is unlikely to qualify retroactively should the proper category be created. "I don't really give a damn about records," he laughs. "I would do it even if no one knew I was doing it."

Thermal flying, the most common kind of gliding, does not require any special geologic structure. All that's needed is the sun to warm the ground and develop up-and-down currents. Warm air rises until it reaches a height called the condensation level, where moisture condenses out of it and forms a cloud, eventually ending its usefulness to the pilot.

The strongest conditions are found in high-altitude deserts, like those of New Mexico and western Texas, South Africa, and Australia; the moisture content of the air is so low that thermals can rise four miles above sea level before condensation occurs.

In ideal conditions, up to half the sky will be covered with cumulus clouds perched atop thermals; the more clouds appear, however, the less sunlight reaches the ground, and eventually the lift can shut itself off. The thermalling pilot moves from cloud to cloud, circling under each to gain sufficient height to carry him across the sink to the next. He judges a thermal by the appearance of its cloud cap; a rough, blurry bottom means a building thermal.

The world soaring championship, held every other year, is usually a thermalling contest; this year it took place in July and August in Uvalde, Texas. No ridges, no mountain waves—just flat Texas plains and a boiling kettle of air above them.

The best pilots are the ones who pick the right thermals, know how to climb most rapidly in them, and are bold enough to leave them at the earliest possible moment. The pilot who hesitates in a thermal for an extra turn or two, uncertain whether he will reach the next, wins no contests and sets no records. The instincts required are subtle; the few pilots who possess them at the level of world competition are regarded with awe by others. Colleagues describe the flying of Australian Ingo Renner, three-time world champion, as "uncanny" and "supernatural."

The dean of U.S. thermal flyers is 67-year-old Wally Scott of Odessa, Texas. With over 5,000 hours of cross-country gliding time in his logbook, Scott can look back over a 30-year career of distance flying that includes four world records. Like other distance pilots, he is a fervent student of the weather. Ninety percent of his long-distance flights have taken place in the first two weeks of July, when the atmospheric instability of summer has set in and the condensation level is at 16,000 feet or high-

er. He has landed in Nebraska 20 times, but most of his longest flights—over 700 miles—have been on the rare days when the wind blows out of the east and he flies not northeast but west to New Mexico and Arizona.

Scott has visited the fertile record country of the Bald Eagle Ridge, but he prefers Odessa. Of the ridge pilots, he says, "Their world is half a mile wide and 500 miles long. Mine goes a thousand miles in any direction." But he recognizes that both ridge and wave flying offer greater potential for distance than thermals do. He knows that it is waves, not thermals, that hold the key to the elusive 1,000-mile straight-distance flight.

Despite the progress that has been made in refining sailplane performance, the absolute straight-distance record remains where it has been for nearly 20 years: in the hands of a 68-year-old German clothing store owner, Hans-Werner Grosse. On April 25, 1972, Grosse flew 908 miles from Lübeck, West Germany, on the North Sea, to Biarritz, near France's border with Spain on the Bay of Biscay. Grosse's distance surpassed the previous record, set by Wally Scott, by almost 200 miles.

Grosse rode on the tail end of an arctic air mass descending from the northeast across western Europe. This is a comparatively infrequent phenomenon; still rarer is the luck to pick the perfect moment to hop aboard. The later the better, because the weather in the middle of the air mass is showery or snowy—but a little too late and the moment is gone. Grosse foresaw the opportunity for three days but resisted the temptation to depart. His luck consisted in the synchronization of weather and daylight; had the front arrived 12 hours sooner or later, his flight would have been impossible.

Records can be set in two kinds of one-way distance flights: goal and free distance. In a goal flight the pilot states in advance where he intends to land; in a free distance flight, he simply goes as far as he can. That April day Grosse declared as his goal the French town of Nantes, 720 miles away; it would have been a solid world's record for a goal flight. Over Holland and Belgium he was swept southwestward like a whitecap by winds so strong that sailplanes on the ground did not dare to take off. By 4 p.m. he was over Nantes.

"The only thing in the flight that I'm proud of," he says, "was the decision to abandon the goal flight and an infallible world's record." Riding a tiger, he decided to go all the way. In rough conditions and weak lift he fought his way crosswind along the Atlantic coast and gradually inland. Finally he found blue sky and cumulus clouds near Bordeaux, and the rest was easy.

By a quirk of cartographic chauvinism—Grosse's French chart did not show the location of the airstrip at San Sebastián, across the border in Spain—Grosse felt it would be rash to continue on to there, though he had ample altitude: "It was the utmost in luxury, cold, exhausted, to throw away that altitude that I had gained centimeter by centimeter." He popped his drag chute and landed at Biarritz.

A man of great cultivation and joie de vivre, Grosse counts himself a thermal pilot and is proud of it. The Appalachian ridge, he says, doesn't attract him; "Thermalling flight is free flight, liberated flight!" He has done a little wave flying but dislikes the technical requirements—transponder, oxygen, authorizations from air traffic control to invade airline altitudes—and feels, anyway, that the expertise of regular wave pilots will always be superior to his. Grosse does not want to be an average player at another's game: "I want to find out the ultimate that can be done."

KARL STRIEDIECK

Grosse owns a two-seat sailplane now, and he and his wife Karin have set six world's records together, in addition to the six that Grosse holds alone or with another pilot. They have attempted—as yet unsuccessfully, but they will try again—a flight from the North Sea to the Mediterranean, which would qualify for no particular record but which has the geographical romance that makes it a dream flight for Grosse. This impulse is unusual among distance pilots; most have little concern for the historical or cultural resonances of their points of departure and arrival.

As old as it is, Grosse's record will not stand forever. A 36-year-old mechanical engineer from Los Angeles, Mike Koerner, flew 903 miles in 1984, from California City, about 100 miles north of Los Angeles, to Seminole, Texas.

For him, the significance of the flight was not its length but its success under less than optimum conditions. Koerner was late getting off the ground; fuel had to be scrounged at the last minute when it was discovered that the towplane was empty and the gas pumps hadn't yet opened. Then the wind was not what he wanted, and he didn't make up his mind to go for the distance until he had gotten too far downwind to make his way back to Cal City.

Koerner is certain that the potential exists for much longer flights. Sailplane design and construction have made great advances in the last two decades. The single greatest innovation was the use of graphite composite, the same stuff used to make expensive fishing poles, golf clubs, skis, and tennis rackets. Its light weight and stiffness made possible wings spanning almost 90 feet, and in the past 20 years the best glide ratios attainable by sailplanes have increased from 40:1 to 60:1, meaning that for every mile of altitude they achieve, they can glide 60 miles in still air. Instrumentation is also improving: computerized gadgets can tell the pilot nearly everything he could want to know about what he's doing and what he ought to do next. These days the distance a sailplane can fly sometimes seems limited less by its own performance or by the skill, patience, and intelligence of its pilot than by the geography of our planet, the length of the day, and the size of prevailing weather systems.

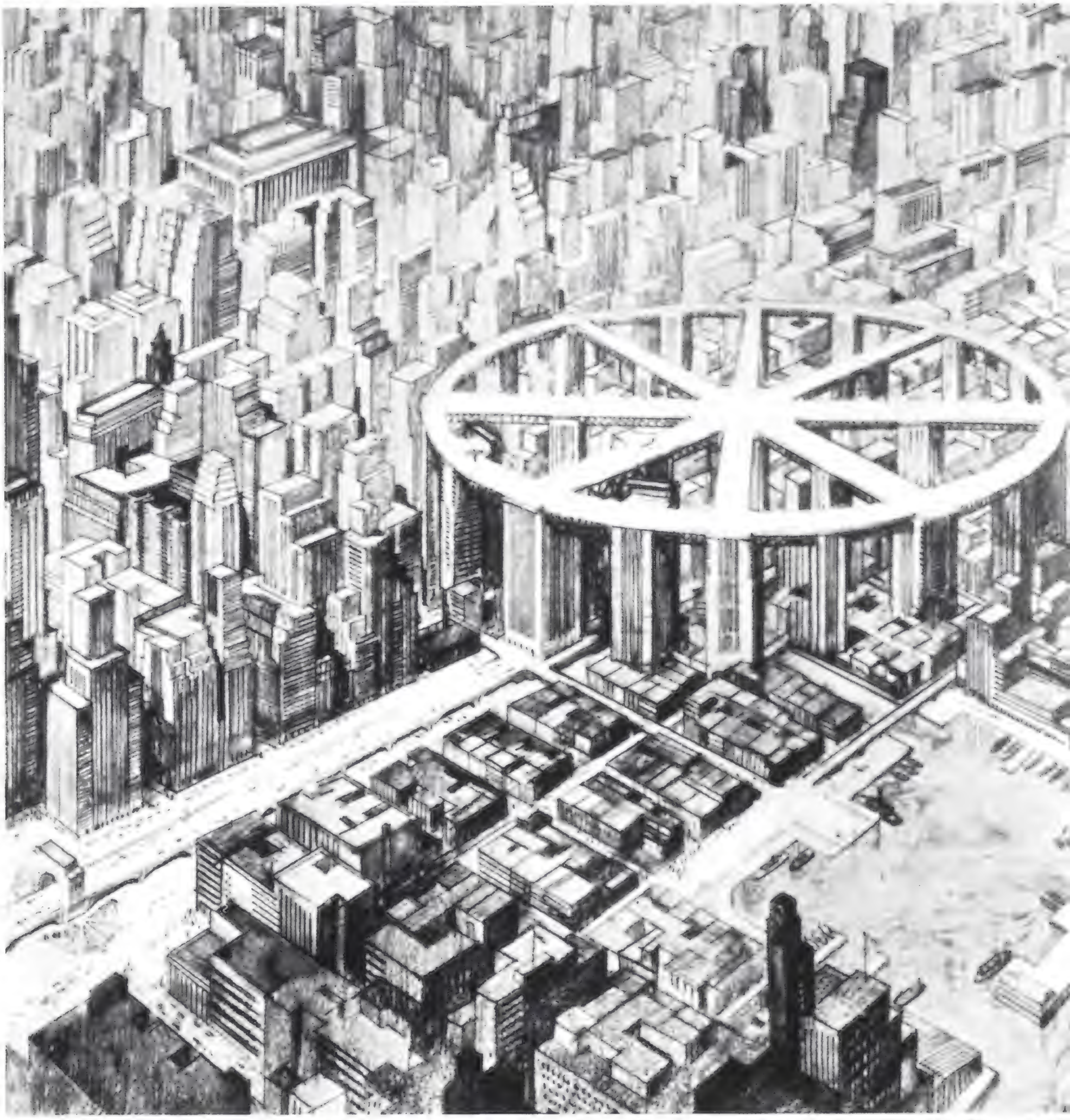
WALLY SCOTT

But the atmosphere, says Koerner, is far more complex than our mental models of it, and a pilot can dream of ever wilder possibilities. Koerner speaks with suppressed excitement about the idea that one might ride the convection over the warm Gulf Stream in a sailplane equipped to land on water; about using the entire coastline of a continent as a ridge, harnessing the slight uplift of an onshore flow; and even about running the rapids in the geysering hearts of thunderstorms.

Maybe, just maybe, in a few years, a pressurized sailplane could climb the waves to 50,000 feet, hitch a ride on the jet stream at 200 mph or skip from wave to wave like a pebble on water all the way from California's Sierra Nevadas to the Colorado Rockies, hold overnight in the Pike's Peak wave, and then strike out in the morning over the Great Plains, a thousand miles already behind it and thunderstorms building ahead....

Perhaps it is not, after all, geography, daylight, and weather that limit the distance a sailplane can fly. Perhaps the only limits are those of human ingenuity, determination, and endurance—the least certain limits of all.

THE GREATEST AIRPORTS N



LEHIGH AIRPORTS COM

EVER BUILT

H. A. IVAMEY

PETITION

A 1929 design competition brought out the first grace notes in airport architecture.

The 20th century sometimes seems to have passed before us in the blink of an eye, so quickly do we now accommodate enormous change. And yet on occasion some small object or event will appear that for a moment resets our perceptions of time, so that the not-so-distant past seems suddenly to have happened long, long ago. The drawings in a little book entitled *American Airport Designs,* initially published in 1930 and recently reprinted by the American Institute of Architects Press, collectively constitute one such provocative artifact.

The book is a compilation of 44 designs

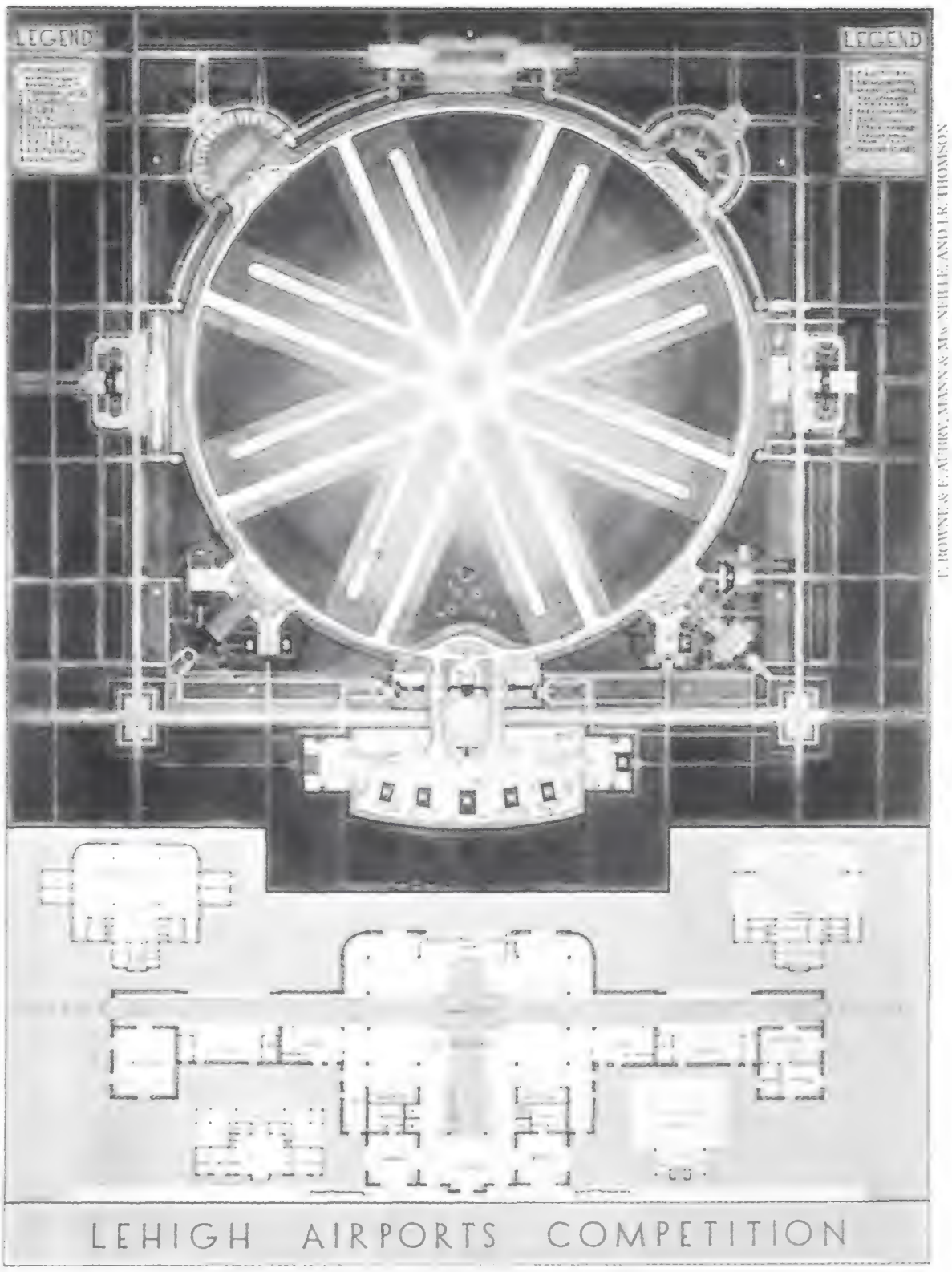
Looking like a gigantic asterisk that wafted down from the heavens, this runway plan is American Airport Designs' *most unabashedly futuristic entry.*

by Benjamin Forgey

submitted in 1929 to "the First National Contest for Designs of Modern Airports held in the United States." Rather than seeking designs for an actual planned airport, the competition had the broader aim of getting both the building industry and the public thinking about the needs of the nascent business of air travel. (With sponsorship by the Lehigh Portland Cement Company of Allentown, Pennsylvania, the contest doubtless had a market-expanding agenda as well.)

That such a competition was even necessary says much about the state of air travel at the time. In the late 1920s flying was still a long way from the well-established routine we know today. Only one out of 2,400 Americans had ever flown on a regularly scheduled airliner. And most of the airports then in existence were nothing more than hangars and service shops alongside open fields. It isn't surprising, then, that so many of the contest entrants looked back to the great American railroad terminals as starting places for their ideas, just as the railroad station architects had had to search history for clues to designing their huge and hugely unprecedented buildings. (Union Station in Washington, D.C., for example, was modeled on the Roman baths of Caracalla and Diocletian.)

Most of the entries share a certain look: a centralized tower or building mass framed by identical wings; sharply rectilinear profiles stepped back, like the skyscrapers of the day; and classical details, such as columns and pilasters, that have been stripped down and flattened out. Park-like settings predominate outside, and the interiors feature many a noble concourse or waiting room. The planning principles—axiality, symmetry, civic presence, and civic decoration—are those of the Beaux Arts movement, a classical style popular for public buildings in the late 19th and early 20th centuries. But it is Beaux Arts architecture updated to serve the new task and to keep step with the taste of the time. The geometric look is Art Deco—"moderne," rather than the anti-ornamental, pro-industrial, individually expressive "modern" style then being pioneered by the European avant-garde. As in other fields of architecture, it would take a few more

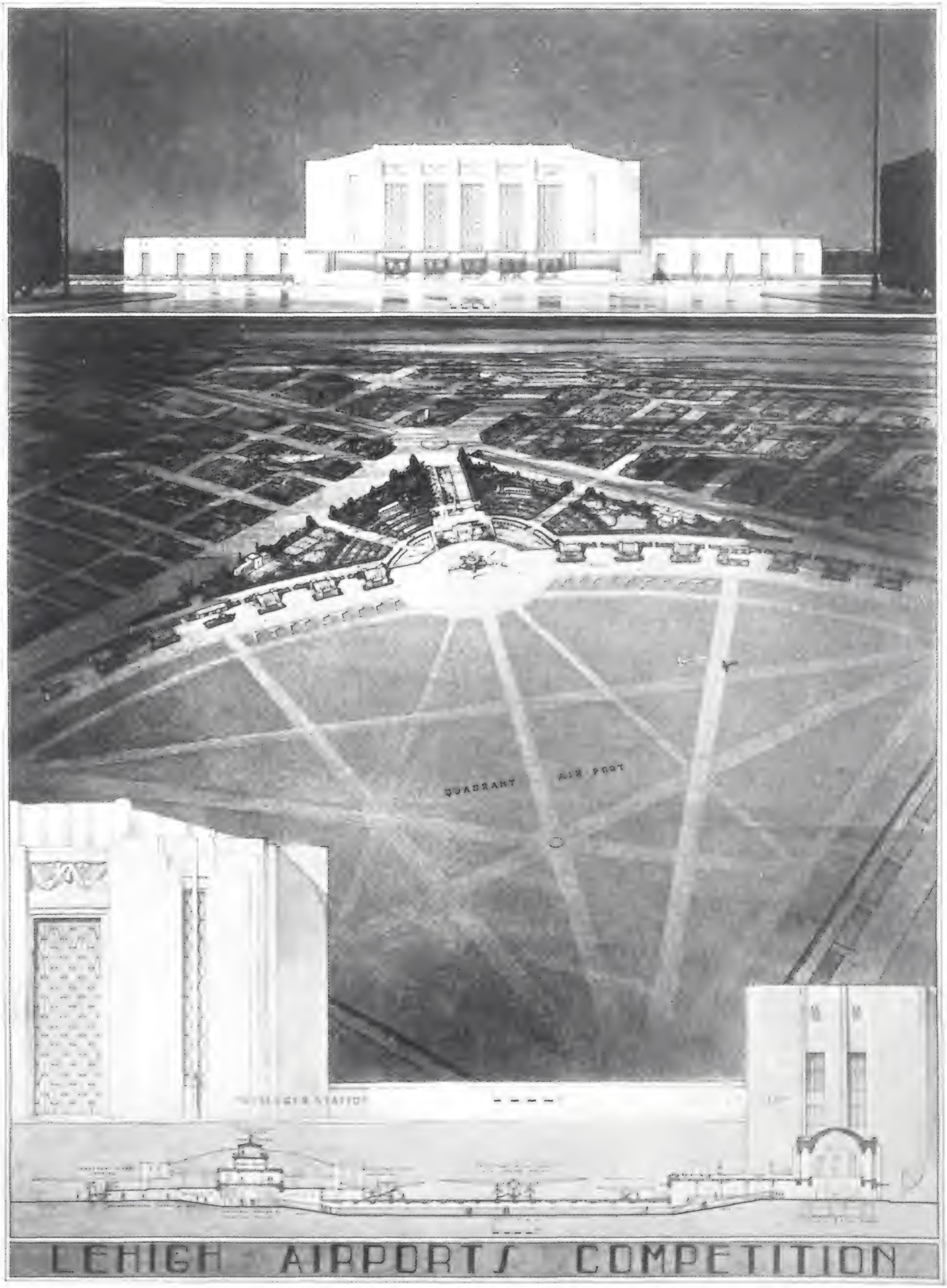


T. BROWNE & E. AUBRY, MANN & MacNEILLE, AND J.R. THOMSON

No matter what the wind direction, the plan above offers one runway for landing and another for taking off.

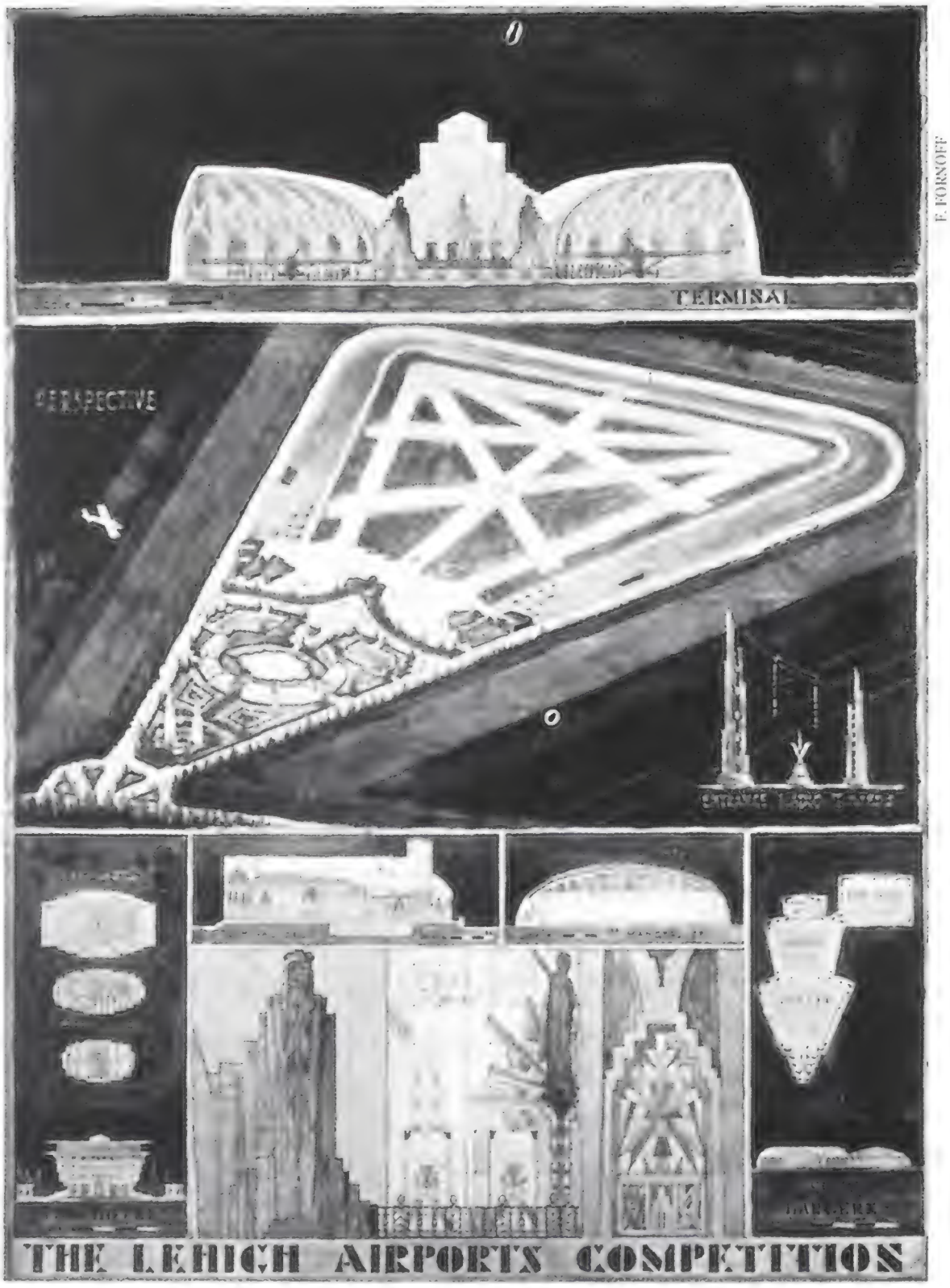
The $5,000 first prize went to a design featuring a Deco-style rotunda that serves as both control tower and loading facility (right). The plan also called for a quadrant-shaped airfield and a terminal commanding enough to resemble a temple (opposite).

A.C. ZIMMERMAN & W.H. HARRISON (C)


QUADRANT
AIR PORT
LEHIGH AIRPORT'S COMPETITION

I. BORDEWICH & W.F. KOENIG

LEHIGH AIRPORTS COMPETITION



F. FORNOFF

decades (and another world war) before truly modern aesthetics would come to the fore in this country's airports, manifested in such memorably expressive facilities as Eero Saarinen's Dulles, outside Washington, D.C.

In addition to architecture, entries were judged on the soundness of their engineering, aeronautics, and city planning. Perhaps it was the pragmatic nature of these criteria that restrained most of the designers from engaging in the kind of spirited speculation about the future one might expect in an "idea" competition. The entries are indeed the airports of yesteryear, small and somehow slow-moving, compared with today's crowded, sprawling airports, which are less like individual buildings than self-sufficient cities. Even so, if one scans these drawings carefully, one gets inklings of the airports of the future—the airports we know today.

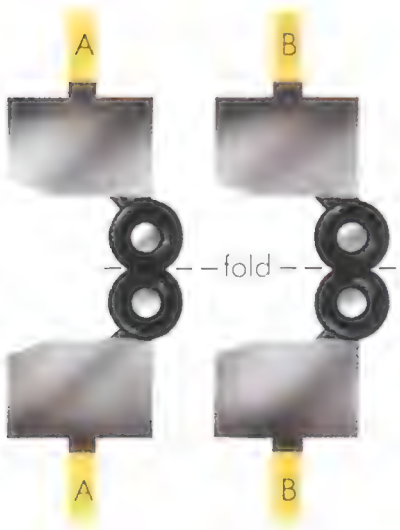
Many designs proposed hotels, athletic and entertainment facilities, and a full complement of restaurants and concessions. Some paid careful and inventive attention to the difficulties of getting passengers, baggage, and freight to and from the airplanes—underground channels are a favored device, as are flexible contraptions rising to the level of airplane doors. And though most of the runway patterns are so elaborate they are downright confusing, they nonetheless represent earnest efforts to accommodate the increase in air traffic expected in aviation's early years.

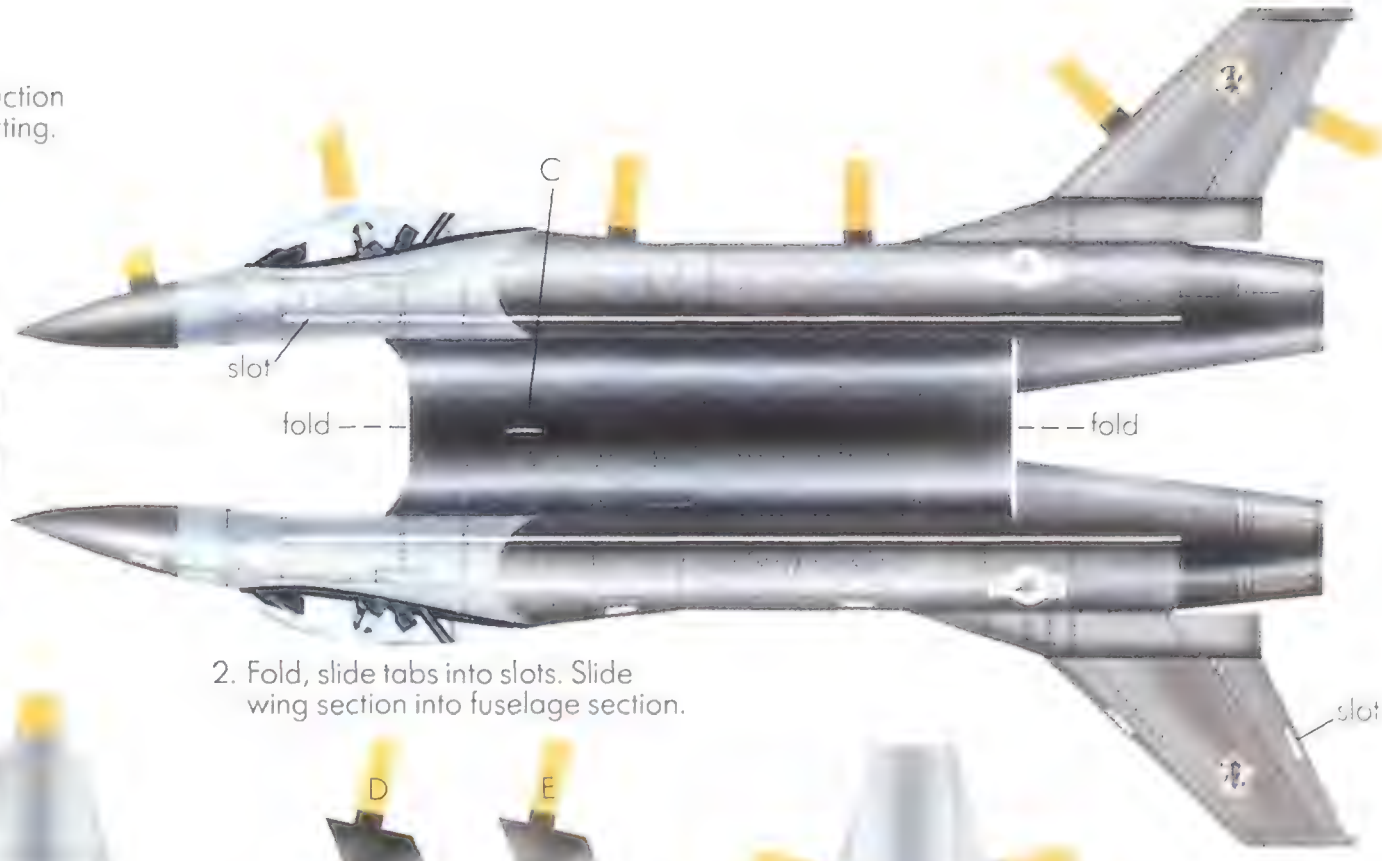
Instead of loading bays, the plan at left provides eight movable turrets arrayed between terminal and airfield. An airplane edges up to a turret, which is then swung into position for loading.

The architecture of the design above has a grandeur one commentator found to be "carried considerably beyond the point of economic justification."

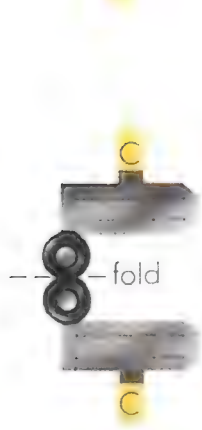
These are issues that still bedevil airport architects. The biggest challenge of all, however, may be the one that most of these architects proved themselves equal to 60 years ago: designing an environment that serves a unique and demanding purpose and is, at the same time, comforting, delightful, and civilizing. If the entries have a certain sameness, it must also be said that the architects used a very good cookie cutter. In both large matters, such as the disposition of public spaces, and small ones, such as the decorative distinction of so many of the windows, these are elegant, commodious, and even beautiful conceptions.

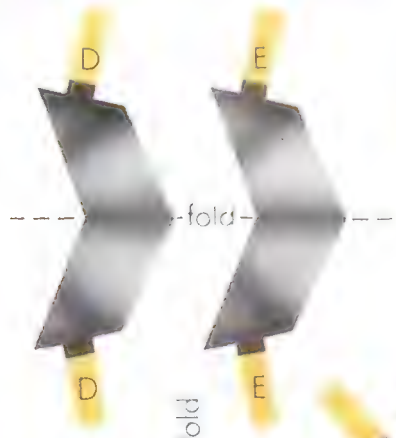
1. Glue page to heavy construction paper and let dry before cutting.





2. Fold, slide tabs into slots. Slide wing section into fuselage section.





3. Insert lettered tabs into matching lettered slots.

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By Gerrit L. Verschuur

This Target Earth

There were no humans alive the last time a large asteroid hit our planet. There may be none left after the next one.

San Juan Capistrano is a small, sleepy town in southern California that sits on the San Andreas fault, which makes it the perfect location for a conference to discuss the end of the world. But for once this gloomy subject didn't bring out wild-eyed madmen with placards proclaiming the day and time of the impending apocalypse. Organized by NASA in cooperation with the Planetary Society, the meeting attracted 150 scientists, mostly astronomers, from two dozen nations.

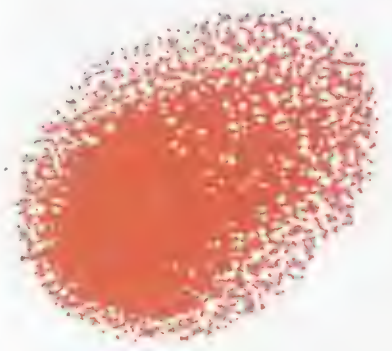
The International Conference on Near-Earth Asteroids was convened last July to compare observations on a class of rocky or metallic objects that range from 10 feet to 10 miles in diameter and every so often intercept our planet's orbit. They usually miss Earth, but if we were to collide with one, it could spell the death of millions of people, if not the end of civilization as we know it.

Almost all the asteroids in our solar system reside in a fairly well-defined belt between the orbits of Mars and Jupiter. Astronomers believe that they are chunks that never coalesced into a planet. Near-Earth asteroids weren't discovered until 1932, and since then only about a hundred have been identified. But scientists estimate that there may be as many as 10,000 large enough to inflict considerable damage if they were to collide with our planet. On March 23, 1989, an asteroid half a mile in diameter came within 400,000 miles of Earth, missing us by a mere six hours. And only six months prior to the conference a 30-foot asteroid had missed us by only 106,000 miles.

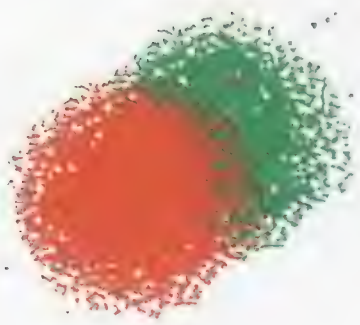
Such close calls aren't as unusual as we would like to think. At the conference, Steve Ostro of NASA's Jet Propulsion Laboratory in Pasadena, California, provided a vivid analogy that clarified the danger. He invited the audience to imagine the Earth-moon system as a dartboard, with Earth as the bull's eye and the moon's orbit as the board's outer ring. He then asked us to imagine that each asteroid large enough (50 feet or so across) to produce a blast equivalent to an atomic bomb's would light up as it entered this dartboard. According to Ostro, you would see a flash of light every several hours.

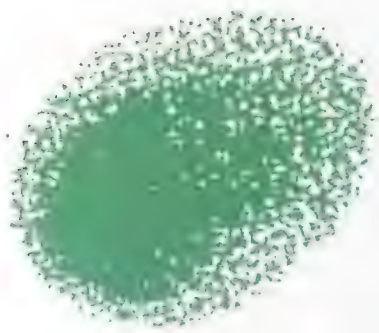
According to Eugene Shoemaker of the U.S. Geological Survey, the chance that a half-mile-wide object will strike Earth in the next 100 years is one in 1,000. The odds are the same, Shoemaker added, that an object half that size will hit us within 25 years. Even more sobering were the statistics presented by Clark Chapman of the Planetary Science Institute in Tucson. He estimated that an individual in the United States is three to four times more likely to die in an asteroid catastrophe than in an airplane crash. (Of course, that figure reflects the fact that far more people would die in an asteroid collision.) The conference was rife with these kind of doomsday predictions, though they weren't inspired as much by scientific one-upmanship as by a desire to show the magnitude of the danger.

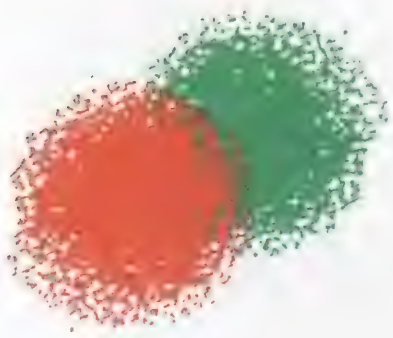
Shoemaker, who together with his wife Carolyn are pioneers in the search for near-Earth asteroids, did urge some caution in defining the threat to our planet. After all, he said, two-thirds of Earth is covered by water, and even if an asteroid landing in the ocean churned up a tsunami that killed an



The first warning of a collision may be no more than a speck on a photographic plate. This image is adapted from two photographs of Asteroid 1989FC taken 50 minutes apart. When the first image (red) is placed over the second (green) and slightly displaced, the asteroid's movement in relation to the stars becomes obvious. A half-mile in diameter, the asteroid missed Earth by a mere 400,000 miles on March 23, 1989.







unprecedented number of people, it might not destroy civilization. Another scientist did not take well to this distinction. "Humanity is ill-advised to say the probabilities are so low as to ignore them," he warned.

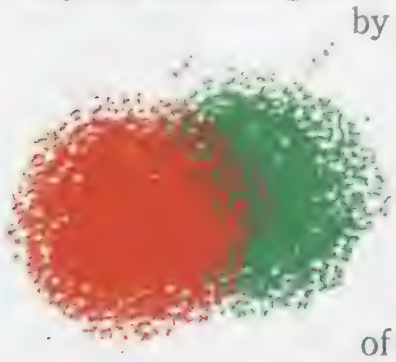
The scientific community became interested in near-Earth asteroids a decade ago, when Nobel Prize-winning physicist Luis Alvarez and his colleagues made a curious discovery. They found that the relatively rare metal iridium was present in large amounts all over the world in a layer of clay that dates back 65 million years, to the time between the Cretaceous and Tertiary periods—the so-called KT boundary. This was when more than 50 percent of all species on Earth, including the dinosaurs, were wiped out, an event that has never been adequately explained. Alvarez argued that the iridium could have been left behind when an asteroid struck our planet with unimaginable fury, vaporized, and wiped out much of the life on Earth.

If the dinosaurs had been killed by an asteroid, where did it hit? The geological record suggests that around the time of the extinctions, Earth may have suffered multiple impacts. More than a hundred impact craters have been identified around the world. One was discovered near Manson, Iowa, though it is only about 20 miles across, too small to have been created by an asteroid capable of causing the major extinction. Recently scientists have discovered a more likely suspect: Chicxulub, a 124-mile-wide crater that extends from the town of Puerto Chicxulub on the tip of Mexico's Yucatan peninsula to the Caribbean Sea. "Now we've seen the smoking cannon and the smoking pistol," Shoemaker noted.

It would have taken an object six miles in diameter to create a crater the size of Chicxulub. To show the devastation such an impact would cause, Ronald Prinn of the Massachusetts Institute of Technology in Cambridge presented a computer-simulated scenario of the aftermath. As the asteroid passed through the atmosphere, a shock wave created intense heat, igniting forests and grasslands for thousands of miles around the impact site. The sudden atmospheric heating also formed nitric oxides, which later produced acid rain. As the resulting dust and soot turned day into darkest night, the earth was defoliated, and photosynthesis ceased on most of the planet. For perhaps as long as a year the planet froze, until the clouds cleared and the carbon dioxide released by the vaporization of terrestrial rocks led to global warming.

For Prinn, the question of how the dinosaurs died has been answered. "The problem is no longer worrying about how to cause extinction," he said, "but to figure out how anything survived."

David Morrison of NASA provided a rule of thumb for calculating the energy of an asteroid impact. The energy of an asteroid striking Earth at a typical speed of 24,000 mph is 50 times greater than that produced by the same amount of TNT. A six-mile-wide object such as the one believed to have triggered the KT extinction would strike with the force of a 100 million-



FROM PHOTOGRAPHS BY HENRY HOLT

ROGER RESSMEYER/STARLIGHT (2)

megaton TNT explosion—10,000 times what the combined nuclear arsenals of the United States and the Soviet Union could produce.

Fortunately, such devastating impacts happen only about once every 100 million years. It is the more frequent collisions with smaller objects (from 300 feet to a half-mile across) that pose the immediate and continuing threat to our survival. One has occurred as recently as this century. In 1908 a remote part of Siberia known as Tunguska was rocked by an explosion equal to 10 to 30 megatons of TNT when a small comet, probably a piece of ice and rock, entered Earth's atmosphere and exploded before it hit the ground. John Pike of the Federation of American Scientists recounted that the Tunguska blast totally devastated an area roughly the size of Washington, D.C. A collision of that magnitude in an urban location today could kill up to 330,000 people.

"Tunguska" has become a standard unit for measuring cosmic catastrophes similar to the explosion that ravaged Siberia. "The conventional view is that Tunguska events land in Siberia and therefore represent no danger," Victor Clube of Oxford University in Britain told the conference participants. In fact, he said, nothing could be further from the truth. If other multiple-Tunguska events have occurred, even as recently as the last century, we would probably not know about them because the world was simply too sparsely populated. Clube believes that myth, legend, and folklore are replete with information about such events. "Paradoxically," he observed, "despite our current ignorance of global Tunguska bombardments, they were known to our ancestors."

One possible multi-Tunguska event took place about 800 years ago in the South Island of New Zealand, when, Maori legend tells us, the entire island burnt to the ground. Duncan Steel of the Anglo-Australian Observatory in New South Wales and Peter Snow of Otago, New Zealand, have made a convincing case for an asteroid impact based on the findings of soot deposits in geological layers from that age.

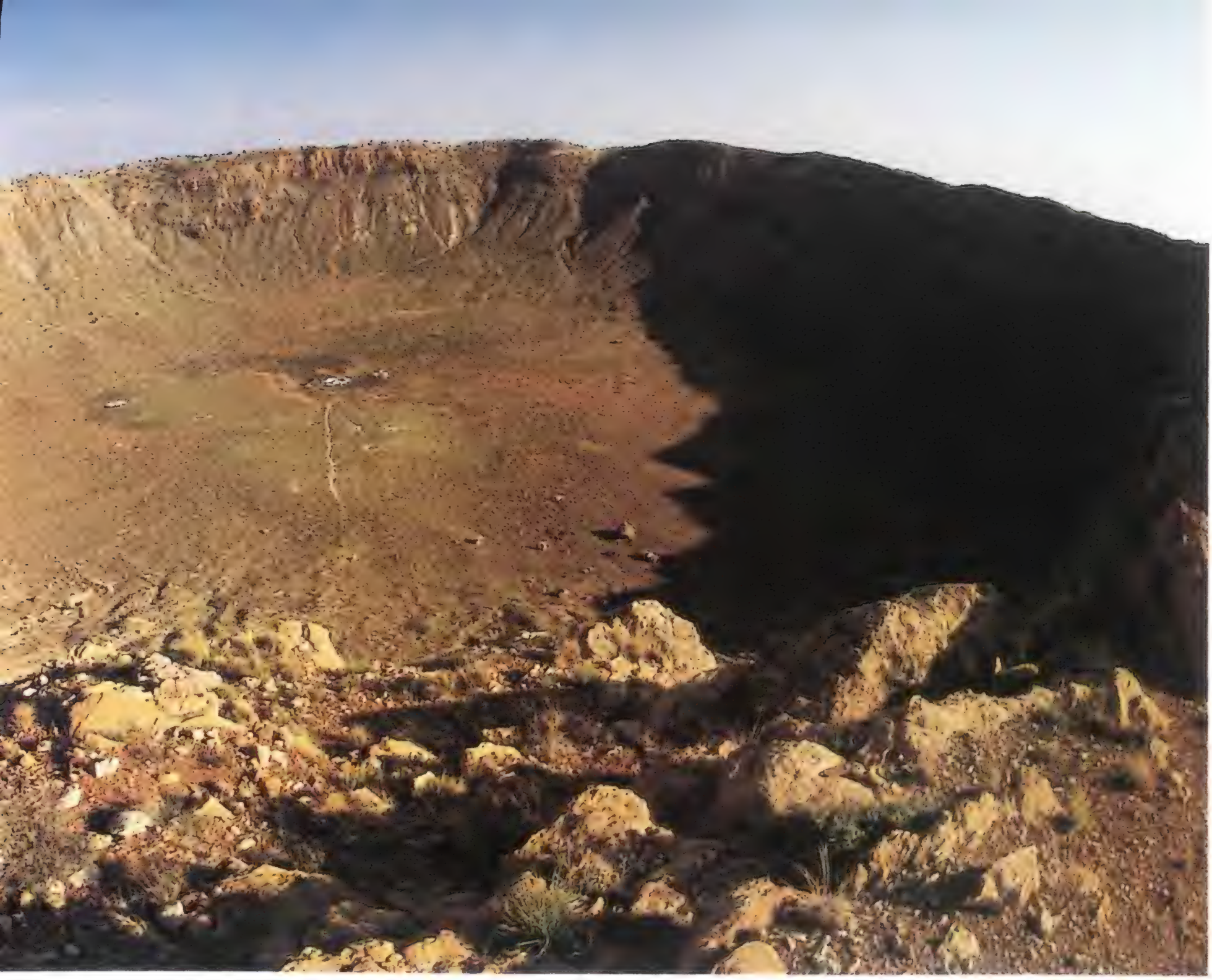
Fortunately, we are getting better at detecting the trespassers. In the 1970s the discovery rate was three per year; now it is 30 per year and rising. Eleanor Helin of the Jet Propulsion Laboratory has bagged 55, making her one of the most successful searchers to date. Her team, the Palomar Planet Crossing Asteroid Survey, made its first discovery on July 4, 1973, and since then Helin has logged more than three years' worth of observing time at the 18-inch Schmidt camera at Mount Palomar in California, taking 30 pairs of exposures per night. Making a pair of exposures at different intervals and comparing the photographic plates under a microscope enables her to detect whether an object has moved. Helin wears dark glasses constantly, as if she wants to stay dark-adapted all day.

N.J. Collela of Lawrence Livermore Laboratory in Berkeley, California, hinted that the detection of near-Earth asteroids could get a boost from technology that apparently grew out of "another project we were working on." It was obvious to everyone present that he was referring to the Strategic Defense Initiative. Collela described a laser system developed to overcome the twinkling of stars, which interferes with the ability to track enemy missiles. Having been recently declassified, the laser system could be applied to searching for near-Earth asteroids instead of enemy missiles. It may be time to transfer national resources from SDI to ADI—the Asteroid Defense Initiative.

Once an asteroid is identified, several techniques are used to track it. At Puerto Rico's Arecibo radio observatory, Steve Ostro bounces radar signals off the objects to get an accurate fix on their orbits. Recently, some scientists have been taking orbital calculations and searching through old photographic plates of the night sky to see if the object had been photographed earlier but not detected. (Scientists refer to

Some 40,000 years ago an asteroid weighing 300,000 tons slammed into North America, creating Arizona's Meteor Crater. Scientists estimate that Earth is hit by an asteroid this size every few thousand years.

Luis Alvarez and his son Walter ignited widespread concern about near-Earth asteroids when they theorized that an asteroid collision wiped out the dinosaurs 65 million years ago (left).



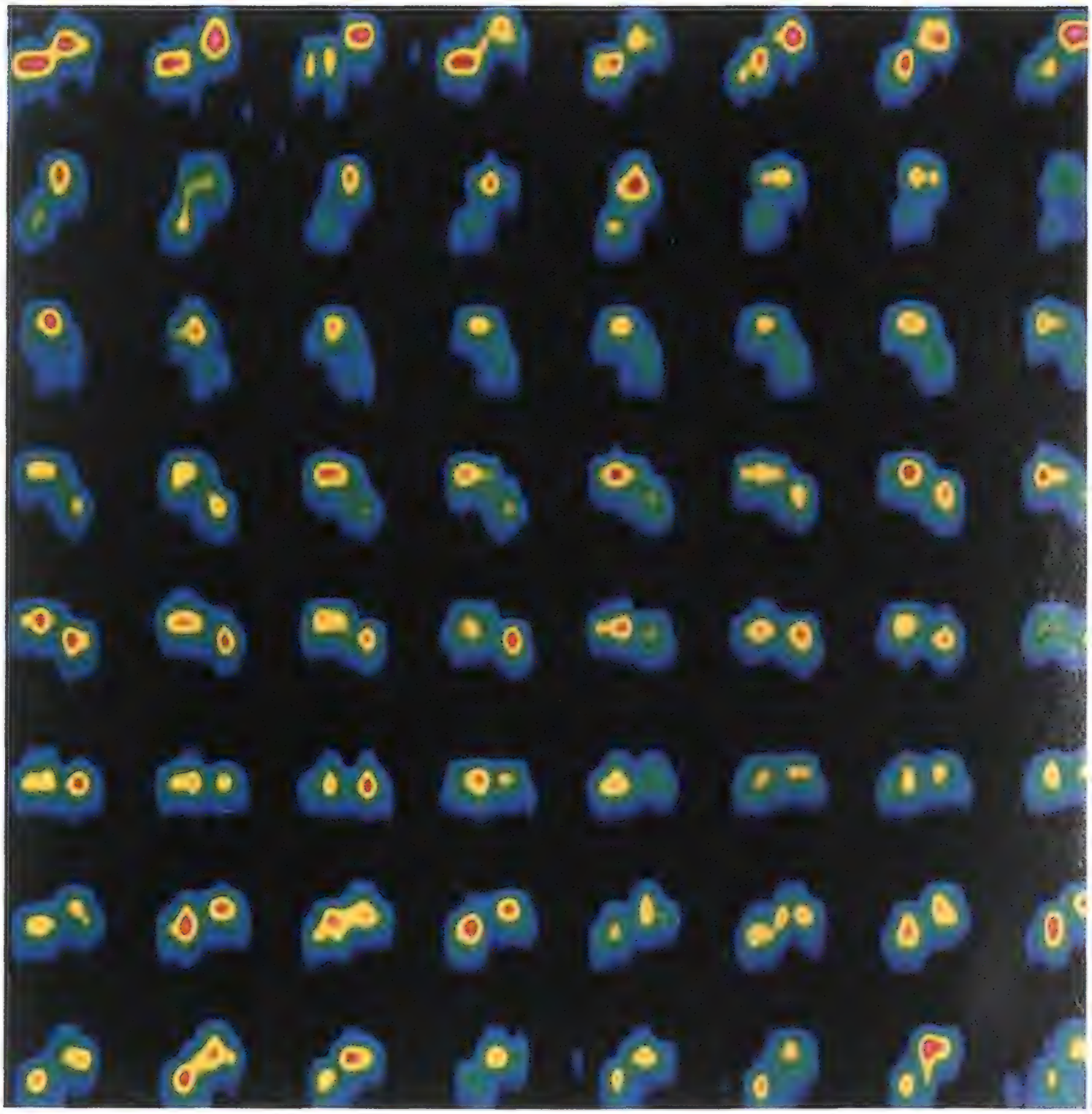
these as "precoveries," as opposed to discoveries.) However, near-Earth asteroids move so quickly that they are often lost before their orbits can be determined. And as A. Milani of the University of Pisa in Italy told the gathering, the objects' orbits may change over time, either slowly or, when affected by the gravity of the planets they pass by, quite rapidly. Of the asteroids discovered most recently, one-third are already nowhere to be found.

As astronomers become increasingly aware of near-Earth asteroids, funding for new science programs in the United States is all but disappearing. To warn of potential danger requires careful searching and orbit determinations. This may become a perpetual search, as near-Earth asteroids are being born all the time—most are ejected from the main asteroid belt due to collisions and gravity perturbations, while others break away from the cometary cloud in the far reaches of the solar system. Unfortunately, current facilities are not discovering the asteroids fast enough: telescopes, viewing time, and people qualified to analyze the observations are all in short supply.

The financial tribulations of the search are personified by the adventures of Tom Gehrels, director of the Spacewatch program at the University of Arizona lunar and planetary laboratory. Gehrels has a slightly frantic look about him and speaks with a sense of urgency, as though he expects disaster at any moment. By the end of the meeting I shared that feeling.

His search for funds began in 1981 and he envisioned as the cornerstone of the Spacewatch program a specially designed 72-inch telescope with state-of-the-art charge-coupled devices to electronically process the light received from space. A computer compares the CCD images to reveal the signature of near-Earth asteroids—moving images against a background of fixed stars. Financing has yet to be found for the large telescope, but Spacewatch began in September 1990 using a borrowed 36-inch instrument.

Spacewatch now finds 200 asteroids per month, almost all of which orbit harmlessly in the main belt. However, the team has



Radar has become an important tool for tracking near-Earth asteroids. This sequence of radar images (read left to right) depicts near-Earth asteroid 1989PB over a period of two and a half hours. The asteroid, which rotates counterclockwise, consists of two lobes, each a half-mile in diameter.

found 15 near-Earth asteroids, and it expects to find at least as many this year. With better equipment and a new telescope, the detection rate could escalate to 200 a year.

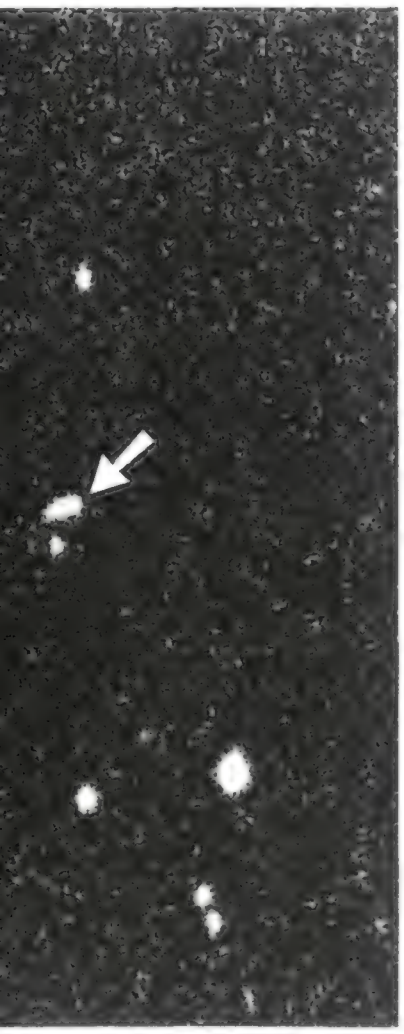
Gehrels is particularly excited about private and corporate sponsorship, some of which he managed to solicit by advertising in the *Wall Street Journal*. He enthuses that "15 percent of our funds come from individuals and corporations, and every check in the mail is a stimulating thing for the crew. This makes our search far more personal and makes us work that much more carefully to turn over each dime." One gentleman in Hiroshima sends a $500 check twice a year and doesn't want his wife to know about it. At present, 230 individuals support Spacewatch, and Gehrels is always looking for more.

Gehrels calculated that if we were to limit our search to only the most massive asteroids—those capable of wiping out all life on Earth—we could accomplish that task in 10 years with a single major facility funded with $2 million in initial capital and an annual operating budget of $300,000 per year. However, he added, if our goal is to detect every asteroid that endangers the human race, "we need five to seven facilities and in 20 years we'd have a good chance of being able to do so."

To accelerate the detection effort, Congress has approved a budget initiative asking NASA to hold workshops to determine what needs to be done. The first workshop, which is to make recommendations on how to improve the search, met during the conference. It hopes to identify approximately 50 percent of near-Earth asteroids in the first decade of the search, and to achieve a nearly complete inventory within the next 25 years. The group's report is due at the end of the year.

If the day should come when we determine that a collision is imminent, we may be able to deflect the approaching asteroid. The easiest way would be to put a small rocket on its surface. A more lethal

Eugene Shoemaker (far right) believes that a rendezvous with an asteroid by a space probe is an important stepping stone in our exploration of space.



JPL/NASA

Eleanor Helin (above left) discovered asteroid 1989PB with the 18-inch Schmidt telescope in California. She took the photo above on August 9, 1989.

COURTESY ELEANOR HELIN

ROGER RESSMEYER/STARLIGHT

approach would be to take aim at the asteroid with a rocket armed with a nuclear warhead; once the warhead was attached to the proper spot on the asteroid, it could nudge it off course. A non-nuclear approach might involve launching a satellite on a collision course with the menace. The satellite could be armed with rods of tungsten, a metal dense enough to break the asteroid into fragments. The challenge would be to direct the fallout away from Earth.

Several less plausible—possibly even hare-brained—ideas for pushing an asteroid into a new orbit were suggested at the conference. One involved spraying the asteroid with black or white paint to change the rock's reflectivity and thus the amount of solar energy it absorbed. Another proposed giving an asteroid an electrical charge so it would interact with Earth's magnetic field and thus change its orbit.

One less combative mission was high on all the conference attendees' list of priorities: a rendezvous with an asteroid. As one participant put it, our fate may hinge on which happens first: will we land on an asteroid, or will an asteroid land on us? Shoemaker believes that asteroids present the next and only logical step in space exploration. "These objects represent stepping stones into deeper space," he said.

In late October of this year, the Galileo space probe will attempt the first flyby of an asteroid. The spacecraft will sail within a thousand miles of a 10- to 20-mile-wide asteroid named Gaspra in the main asteroid belt and photograph it. In 1993 Galileo will have another rendezvous opportunity, this one with an asteroid named Ida.

Whatever action we take, it will have ramifications outside the United States. The search for near-Earth asteroids requires telescopes at locations around the world, and the use of nuclear warheads against them would require an international agreement, what with the various arms treaties involved. An organization like the United Nations might be the best vehicle for mediating a worldwide project of this scope.

Scientists from the Soviet Union have been active in the search, perhaps because it was Siberia that had to endure the Tunguska explosion 83 years ago. The Soviets, not surprisingly, also suffer from a lack of funding. "President Reagan said that what we needed to unite the nations of the world was a common enemy from space," said A.J. Sokolsky of the Institute of Theoretical Astronomy of the Soviet Academy of Science. "Now we have a common enemy."

Asteroids may not have been what Reagan had in mind, though they will do. But will we take action? Human beings are vulnerable to delusions of invulnerability, which allow them to live on a flood plain or set up a trailer park in the Midwest's tornado country. Or, for that matter, hold a scientific meeting on

Given enough warning, we could launch a mission to divert an asteroid before it strikes the planet.

PAMELA LEE

top of the San Andreas fault. This syndrome is likely to prevent our taking seriously any large-scale attempts to predict and then avoid disasterous impacts with asteroids.

Scientists are now in the awkward position of sounding like Chicken Little. When I told an acquaintance about the magnitude of the threat, she couldn't take it seriously: "God won't let it happen," she said. Upon reflection she modified this to "If it happens it was meant to happen."

Obviously, we have much to learn about near-Earth asteroids in the coming decade. In the meantime, we mustn't remain like the crew of an imaginary *Titanic* arguing about which lifeboat we should launch. The question is not whether we will be hit, but when, and what we will do about it.

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by James Salter

A SINGLE DARING ACT

Over Korea, there were a few pilots who could wield a jet fighter called the Sabre like a terrible swift sword.

Colman's arrival in the wing—in fact, there were two arrivals, the first having gone unnoticed—made him famous. He often told the story himself, in an awkward sort of way, laughing and revealing cigar-stained teeth.

He had been in a National Guard wing at a base in northern Japan—Misawa, I think. I have never been there, but I know the drabness, the cold of the mornings. They were flying dangerous, repeated raids on enemy supply lines. Coming back from a mission one day he had what he claimed was a mechanical problem and landed at our field. While the mechanics were unhurriedly attending to his airplane—it was an F-84, exotic to them, with straight wings and heronlike landing gear—he made his way to wing headquarters, not far from the flight line. There he asked to see the wing commander. For what reason, they said, and who was he? It was concerning a transfer. He was Captain Philip Colman.

The wing commander looked like a fading jockey and had the uncommon name of Thyng. He had piercing blue eyes and wore eagles that, because of his smallness, seemed doubly large. I can hear his voice as his plane suddenly whips over on its back, "MiGs below us, fellows!" Down we go.

Colman stood before him with a respectfulness untinged by the least subservience. He was, after all, only tossing the dice. He was that dauntless figure, a free man. Soldier, yes, but only occasional soldier. It was all somehow implicit in the crispness of his salute, his effort to be unsmiling, his stained flying suit. He was an experienced fighter pilot and an ace in China, which had been only seven years earlier. At the moment, he explained, he was in fighter-bombers, which was a waste of his talent; he would like to come to the Fourth.

Thyng was always on the lookout for able men. Did he have any time in the F-86? he asked Colman. Yes, sir, Colman said, about two hundred hours. He actually had none and had merely picked a figure that seemed probable. Thyng, impressed, told him to leave his name and other details with the adjutant and he would see what could be done.

Adapted from the Spring 1990 issue of *Grand Street*. With permission

NORTH AFRICA

The Korean War was the first in which jet-to-jet warfare was waged, and the United States counted on the North American F-86 Sabre. The F-86, which debuted in 1947, had a top speed of 693 mph and was a favorite of the pilots, who found the airplane to be both technically and aesthetically pleasing.

A few weeks later orders for the transfer came through and Colman left for Korea carrying, at his own suggestion, his flight records with him. These records, sometimes sent separately, are a pilot's full credentials and are sacred. They list everything—every flight, date, weather, type of aircraft. En route to Korea, Colman slid open the window of the transport plane and casually dropped this dossier into the sea. The pages, torn apart, slid under. Fishes nosed at the Japanese planes shot down, night flights in Georgia and Florida, rail-cuts near Sinuiju, the entirety.

In the new squadron, the one I was soon afterwards to join, Colman was asked for his records. They were being mailed, he said blandly. In the meantime, for convenience, he offered a rough breakdown of his time, very close to the fact but including several hundred hours in the F-86. Like the bill in a fine restaurant, it was an impressive sum.

Airplanes are the same in the way that ships and automobiles are the same; they are similar but there are also specifics.

On his first flight Colman climbed into the cockpit and after a few minutes beckoned the crew chief to him. It had been awhile since he'd flown this model and he didn't want to make a mistake; why didn't the chief show him the correct way to start the engine? he asked. The rest was easy—radio, controls, instruments, all these were the usual. He taxied out behind his leader and off they went on a local flight. They were carrying drop-tanks but Colman hadn't found out how to turn them on. As they were flying along about forty minutes later, he saw every needle wilt. His engine had stopped.

He had a flame-out, he reported.

"Roger," the leader said. "Try an air start."

This was another gap in his knowledge. "Just so I do it right," Colman said, "read it to me off the checklist, will you?"

Item by item they went through the procedure. Nothing happened. The engine was all right and there was plenty of fuel, but it was all in the drop-tanks. They tried a second time and then declared an emergency. Colman would have to try and make a dead-stick landing.

COURTESY JAMES SAUER

He might have done it easily except he was a little short of altitude. Nothing can make up for that. At the end, seeing he was not going to make it, he picked out the best alternative he could, railroad tracks, and landed on them wheels-up, which was the correct way. He went skating down the rails as if they were a wet street, finally coming to a stop just inside a wire mesh gate which happened to be the entrance to the salvage yard. The airplane, damaged beyond repair, would have ended up there anyway. Eventually the fire trucks came, and an ambulance, and Colman, who had injured his back slightly, was taken to the hospital.

One of the first things noticed in the wreckage was that the drop-tank switches had not been turned on. The squadron commander was in a very unfriendly mood when he arrived at the hospital. As soon as he entered the room, Colman held up his hands defensively. "Major, you don't have to say it," he began, "I fucked up. I know I fucked up. But you have to admit one thing. *After* I fucked up, nobody could have done a better job."

Impudence saved him. He was in disgrace but at the same time admired. You could not help liking him.

He was, in many ways, incomparable. I was a member of his flight and we flew together many times. In place of a regular plastic helmet, he wore an old leather one he had brought with him, probably from China days. His head, as a result, looked very small in the cockpit. Like rivulets feeding a stream, the planes would join the main body as it moved towards the runway. The mission was forming. One of the ships seemed to have a mere child piloting it. Who was that? the colonels asked. "Colman."

He also, for a time, carried binoculars. Someone had suggested they might be a help for distant sightings and he rounded up a pair. We were encumbered in the airplanes—heavy clothing, life vest, pistol, flares—and on top of all this and his knotted, white scarf, the binoculars hung. They were not very practical; their field was small and the sky they jerked across, immense. He pretended they were useful. He was like Nelson holding a telescope up to his blind eye. In any situation he was ready to engage. In this he was like Quixote with whom he shared certain characteristics, though he was not, like the knight, a deeply serious man.

In the air he was imperturbable and, rarer, magnanimous. We were in many fights together, often uneven fights, but his mere presence, he felt, made any odds equal. He was not methodical. He fought the way a man does who has a few drinks and sits down to play poker, the cards may be running right. Cigar in his mouth, he enjoys the game, and if he finds himself over his head can still smile and say good night, or as a famous black champion once addressed reporters, having lost the bout of his life, Gentlemen, I have had a most entertaining evening and I hope that you have, too.

One day I watched him turn, in a huge tilting circle, with the leader of a flight of two MiGs. He had hit him earlier, but at long range, and was trying to finish him off. The wingman had disappeared. Into and out of an enormous sun that seemed to burn black in the sky, we flew. In crossing from side to side to stay in position I had moved slightly ahead and called to Colman that it was me passing in front of and beneath him—there had been cases of mistaken identity. "I'm between you and the MiG."

"Go ahead," he replied. "You take him."

It was a lavish gesture, though no more than I expected of him. It would have been a victory we shared. I had already damaged a MiG a week or two earlier and discovered they were not untouchable. I knew, with the confidence that assures it, I would have many, entirely my own. "No, you've got him," I said.

I was looking behind. It all seemed very leisurely. After a while I heard, "Do you still have him, Two?"

I looked to the front. Nothing.

"I seem to have lost him," Colman remarked offhandedly.

The sickening losses of nearly forty years ago. The leaders have died of old age, the fights along the river in the dusk are forgotten. Still I see it clearly, the silvery fleck that is his plane, the string of smoke that trails from it as he fires, the serenity of it all, the burning fever.

We traveled far together, sometimes to forbidden places, deeper and deeper into Manchuria, almost to Mukden, looking for them in the sanctuary, so high that the earth seemed neuter. It was a great, barren country, brown, without features. The Yalu was behind us, no longer even in sight. Farther and farther north. Every minute was ten miles. No one would know what had happened to us, no one would ever hear. My eye returned to the fuel gauge again and again. The

needle never moved but then it would be lower. How much do you have? he asks. Nine hundred pounds, I reply. Two brief clicks of the mike: he understood. Finally, giving up, we turned.

It was not duty, it was desire. Duty would not search with such avidity in the fading light, coming down the river one last time, the earth already in darkness that was rising slowly, like a tide, the heavens being the last to go. The things I had thrown away, given up—this was what I had thrown them away for, to be here and do this, to be one of them. Along the river a last time. Near its mouth the darkened earth begins to light up, first in one place and then another, like a city come to life. Soon the entire ground is flashing; they are firing at us far below. Black shellbursts, silent, appear around us, some showing an unexpected red core.

It was victory we longed for and imagined. You could not steal or be given it. No man on earth was rich enough to buy it and it was worth nothing. In the end it was worth nothing at all.

We had many aces: Thyng himself, Asla, later shot down, Baker, Lilley, Blesse. In our squadron alone there were Love, Latshaw, Low, and Jolley, as well as latent others with four victories, ready on any day to climb down from their plane in triumph, grinning, genuine at last. For me, though, for reasons I cannot fully explain, Kasler was the nonpareil.

He was in our flight, together with Low. I cannot remember exactly how he looked, and yet in a way I can. The image is like a dream just at the moment it begins to be lost in the light of day. He had a round head, thin lips, cold uninquisitive gaze. He was laconic; the words barely slipped from his mouth. He had dignity, from what I don't know; it had been given to him, I believe, just in case. Skill, of course, great natural as well as acquired skill together with nerve, and a burning patience like that of a lion lying flattened in the tall grass. Crowning it all was the unsentimentality of a champion. He had served a long apprenticeship; he had been a B-29 tail gunner and was older than the others when he got his wings. He was an obscure lieutenant when he came. He left renowned.

There are certain indestructible people—stalwarts, leaders of squadrons and their best followers, mechanics numb-fingered in the cold, bleak colonels with eyes reddened by late hours—all having one thing in common, they are the dikes that stand against aimlessness and indifference, that hold back the sullen waters that would otherwise mingle and flood. Kasler was one of these. I flew on Colman's wing; Kasler, in turn, flew on mine.

Darkness, silence, the dawn mission getting up and appearing, dull with sleep, in the lighted mess hall, gloomily looking into the empty steel pitchers. "Where's the bunja juice?" I hear Kasler ask coldly. The Koreans call the canned orange juice, punch. "Hava-no," they say helplessly. We eat in silence, looking at the tray, and ride in silence down to the flight line.

Two hours later we are over the river. There is the reservoir, the ice of its wide surface crazed with dark lines. It looks like death invading the tissue; all is disorder, all has failed. You can gaze at it for only a few seconds. The sky seems dead, too, abandoned, but can come alive at any moment with fateful glints.

Then it is late in the day again and there has been action. We are looking for them desperately—radar is continuing to report enemy flights—the sun is sinking, the earth beginning to be awash. We fly and see nothing. They're up by the mouth of the river! someone calls. Heading there, the sky remains maddeningly empty and then, in an instant, there are planes everywhere. The impatience, the frenzy—every one we come close to is friendly. A minute or two later we have somehow passed from among them into emptiness again.

Suddenly a plane flashes by beneath: huge tail, red stars, incredibly close. I turn after it, glance quickly behind, my heart pounding. It's clear, but Kasler cries, "Check your right! Look right!"

Not two hundred feet away, plain, foreign-looking, is the wingman. I turn hard towards him and begin to "S" back. He seems fixed, frozen there, like a hare in the headlights. I'm nearly behind him. It will be point-blank. Before I can fire there are four of them almost on top of us, coming in from the other side. "Break left!" Kasler is calling. They turn with us, like cars on a speedway, and we are going down; I can't see if they are firing. Then we are alone; they've broken off

Author James Salter, pictured here after the war, arrived at Kimpo Airfield near Seoul in 1952 (opposite).

The Sabre's chief competitor, the Soviet-designed MiG-15, also owed its swept wings to wartime research in Germany.

SOVFOTO

when we didn't see it. It's over. Above us the contrails are already fading.

Every six weeks or so we were given a few days in Japan. In Tokyo, it was different. We came in from what amounted to the front, unsophisticated, raw, and found the city in the possession of those who were stationed there and had everything—cars, comfortable billets, telephone numbers. It was the life of conquerors, brothels and floor shows, nights of the gods. The taxis were ancient and took you wherever you liked, down ill-lit boulevards and nameless streets.

The Imperial Hotel, the eastern palace Lloyd Wright designed that survived the great earthquake and the war, was standing then. Horizontal, deep-eaved, with green-tiled tubs and the feeling of a ship, its very bricks had been specially made. In its rooms and lounges were civilians, dignitaries, Red Cross girls. They were indifferent to the war in Korea, at least to its unconfirmed heroes. Their interests lay in the capital and the life they were arranging. Looking at them, talking to them, seeking information from them, you saw that it was true; they had everything, but there was one thing they did not have, as the Arabs say: they did not have the truth—that was in the *Stars and Stripes* one morning in early April. I read it sitting in the lobby of a hotel, hotel without a name and day without a date though they had them then: Kasler had gotten his first. It was strange how I suddenly lacked all interest in anything; envy can do that. Coming back from Tokyo it was as if I had never been away, but there was a void, three days during which the war had gone on and which were irreversible.

Something starts and you have your run, like a player at the table or a batter. Kasler's second I actually saw, by chance, hit the ground in a bright splash during a big fight. I was with Colman at the time; we were chasing two but never got close. In the debriefing afterwards I recognized a new contender, one hand bending abruptly behind the other to show how he had done it, the sooty marks of the oxygen mask still on his face. We had been among the countless, he and I, and I watched as if from afar.

At the beginning of May, Colman and Kasler each got their third. I saw them landing afterwards, the planes sleek and bare.

The fourth and fifth I will tell about later.

It was May when Colman flew what only he knew would be his last mission. He had four victories by then, and that day, in a fight near the Yalu, Kasler, leading an element, got his fourth as well and then got behind another MiG and followed it down to the deck. They roared across the mud flats wide open, needles crossed, clothes black with sweat, the MiG like a beast of legend fleeing ahead. Kasler strove to get closer. The controls were stiff. The ground was rushing beneath them. Destiny itself, unrehearsed, shimmered before his eyes.

They were coming to the open water, the delta where the river widened, and suddenly the MiG pulled straight up, climbing, and continuing around. Colman was above with his wingman, watching it all. In his pocket, figuratively speaking, was a telegram he had received that morning—his father was gravely ill, he must come home—when the MiG rose in front of him, the long sought fifth, entire and slow. It was his final chance.

"May I?" he said politely.

Kasler, blood pulled from his face, did not answer. He passed by himself, up, up, and brilliantly over, fierce with lust, heading down again. At the bottom the MiG, going too fast, misjudged and hit near the water. Kasler barely pulled out.

I had landed half an hour earlier from a mission which encountered nothing, and was standing by the barracks watching when they came back. The first thing I saw was that they were without drop-tanks. They turned off the runway at the near end, close to the road. I could recognize Colman's head, small, like a bird's, in the first ship. His gun ports were clean. So were his wingman's. The other two planes had just reached the end of their landing roll. Theirs were black—they had been firing.

Kasler had gotten two and his wingman one. The single daring act—it was hard to imagine the enormous distance that it placed between us. The fifth was more than just another; it was a step across a gulf. I had flown this very flight myself, on the tail of another plane at top speed, closer than one dared, not knowing the other pilot or what he would do, down to the tops of the trees, to the fatal earth; it had been my initiation, but I hardly imagined repeating it in war. Kasler had his fifth, but more than that, he had reordered the state of things: he had begun like me, as a gunbearer, and now was where boldness had placed him, on the other side.

Colman left that same day. In the wake of his leaving I realized that I knew very little about him. He was married and I think had children. He was lighthearted and self-promoting. Day-to-day truth was probably not in him, but a higher kind of integrity was, a kind not wasted on trivial matters. He had an infectious spirit. We were unalike. I adored him.

The farewells were the briefest. He merely picked up and left as if the game had meant little to him, walking out without a backward glance. It was over.

NASM

By the end of the war, Sabre pilots had attained a kill ratio of 10 to 1 against MiG-15s. Most of the aerial warfare took place along the Yalu River in an area nicknamed MiG Alley (opposite).

I have forgotten when Kasler left, sometime later and after another victory; the MiGs had come down south of Anju during the early mission. He saw them low, but couldn't catch them and then it developed there was one behind him. His sixth.

I went to find him as he was getting ready to leave. I had a flight of my own by then and other loyalties, but part of me had stayed behind. We said goodbye. He was somewhat taciturn, as usual. I wondered if he was as yet aware of what he had won and would have for a long time thereafter, the luster of those hunting days when his name became storied.

Later he came by to say a few words—to console me, I think. There would be other chances. Of course, I said. We would see each other sometime, we agreed. It was heartbreaking to see him go, not for the slender friendship we had, but for the achievement he was carrying off with him. I saw his name one other time, in an article all down a column of the *Times* during the Vietnam War. He was flying there. He was known, it said, by name in the war room of the White House itself.

I know how they appeared to me, and I try to step aside for a moment to observe myself, how I seemed to them. Even now I cannot be sure—a marked figure, certainly, convivial and aloof at the same time, not uncourageous, driven, a bit unlucky, or was it unwise? They may sometimes have wondered what happened to me. Did I go on, did I rise?

The first good weather in a week. The fighter-bombers are going north again in strength, to someplace up near the border. The briefing room is crowded and electric. It's maximum effort—everything that can fly.

Far beneath us the silver formations were moving slowly, it seemed, across barren hills. Enemy flights were being announced, one after another, and then someone saw them along the river at thirty thousand feet. Blood jumping after the idle days, we dropped tanks and began to climb. We broke through a thin layer of clouds and into complete emptiness.

Moments later, coming from nowhere, they are on us, four of them at eight o'clock. We turn into them, they pass behind and disappear.

The flight has split up, we're in two's. By this time MiGs are being called out everywhere. The radio is brimming with voices, among them someone calling out MiGs south of the river at twenty-four thousand feet. "How many?" someone asks. "Many many!" We head that way and see two, far out, sail past us on the left. We turn to follow, and they climb and begin to turn themselves. The sky is a burning blue, a sky things seem black in. I am on my back, Immelmanning up to get between them and the river, rolling out slightly beneath the leader who is turning hard to the right and cannot see me. I duck my head and try to find the gunsight which is an image projected onto a thick, slanted piece of glass that serves as the windshield. There's nothing there—turning has pulled it off the glass. The MiG begins to level out and the sight drifts into view. About a thousand feet back I press the trigger. The tracers fall behind him. He begins to climb again and I am cutting him off, closing, glancing quickly back to see if my wingman is still there, firing again. A few hits in the right wing, then tremendous joy, at closer range a solid burst in the fuselage. The flashes are intense, brilliant, as of something vital shattering. He abruptly rolls over and I follow, as if we are leaping from a wall. He begins to pull it through. I am still shooting and something flies off the plane—the canopy. A moment later a kind of bundle, the pilot, comes out.

"Cope! Did you see that?"

"Roger," my wingman says. He may have been talking to me all along, telling me I was clear, but this single word is the only one that remains.

The MiG, now a funeral craft that bore nothing, was falling from thirty thousand feet, spinning leisurely in its descent until its shadow unexpectedly appeared on the hills and slowly moved to join it in a burst of flame.

Six enemy planes were claimed on this mission and two of our own were lost, an ace and his wingman. The leader was rescued but the wingman drowned.

Sabres Unsheathed

Because their airplane could flirt with the speed of sound, F-86 Sabre pilots liked to talk of flying "on the Mach." The United States' first swept-wing fighter, its wings angled back 35 degrees, was powered by a 5,910-pound-thrust General Electric J-47 engine.

Taps for G102

January 1991. Apartment G102, Air Force Village West, California. I hung up the phone and looked across the kitchen at my wife. I stood rooted to the floor. We'd been preparing to make our daily trip to the hospital where my father lay dying of cancer, and I had just been told he was dead.

My wife and I embraced, and I gazed over her shoulder at the world. But not the real world. Not the world of G102, my father's home in this community of retired officers. I was looking back into the past, into the world I'd shared with the man whose heart had just stopped and whose life had shaped me in ways I was only now beginning to understand. The world of a pilot's son in the United States Air Force.

October 1961. RAF Sculthorpe, England. I was a 13-year-old kid at the junior high school at this Tactical Air Command base in East Anglia, playing football during phys. ed. As we huddled, the familiar sound of Pratt & Whitney J-57s spooling up for takeoff washed across the schoolyard. We didn't really notice the shriek, the way New Yorkers don't really notice the traffic noise. We lived in a continuum of engines.

The jet's scream rose, then abruptly ended in a gut-rumbling explosion. We ran to the fence and looked toward the runway. A dirty brown cloud roiled into the gray English sky. The noise on the playing field died as we stared at the smoke. The wail of the fire engines came as the smoke began to drift in the chill air. We looked at each other as we left the fence.

We knew what might happen next: A big blue Air Force car could arrive and some kids could be taken home to be told that their fathers had been hurt. Maybe killed. We wondered, as we always did: *who?*

That day, the blue car didn't come. After school, when I got home, my father's Vauxhall was parked in front of our house. Inside, I found him comforting my mother. The airplane had been his. The starboard engine of his B-66 had tossed a turbine blade and destroyed itself. He smiled at me and asked if I'd been worried. I smiled back. "Nah," I said, and went into the kitchen to get some Oreos. We ate at the O-club that night. His squadron commander bought us dinner. I played pool with my dad. He won. He always did.

DOUGLAS EDWARDS

May 1990. California. For a magazine feature, I needed to find out why General Curtis E. LeMay had allowed the Sports Car Club of America to stage races on Strategic Air Command bases in the mid-1950s. I told my dad about it. He laughed, remembering his own MG-TD and SAC racing. I wondered how I'd get to LeMay, who I knew was living at the Village. "Don't sweat it," Dad told me.

A week later, he called to tell me I had my interview. He'd spoken to LeMay in the dining room. I marveled; as far as I knew, LeMay hadn't given an interview in years. I wondered if he had agreed this time because the story was about sports cars rather than politics. Or if the reason was even simpler, if he'd agreed because I was an Air Force brat. I'd never know.

LeMay gave me two hours. He spoke of sports cars and SAC racing and much more. But of all his topics, the unfulfilled promise of strategic bombing and the genesis of Air Force Village West animated him the most. He told me—anger rising visibly—how little support Air Force officers' widows were getting in their desperate search for affordable housing; how American bankers wouldn't fund a retirement community for career military officers and their spouses; and how he'd had to go to Royal Air Force friends, now senior bankers in England, to get the startup money.

Five months later Curtis LeMay died. My father was one of the three men in wheelchairs in the front row at LeMay's memorial service. Afterward, we talked about where we were going fishing in the spring. But spring never came for him.

As I stood in his kitchen, I gazed around G102 at the few artifacts of an airman's life that fit into a small apartment. On the walls were a few paintings and a pair of blue velvet plaques on which our Air Force decorations and insignia of rank were mounted. I looked at his command pilot wings and wondered what it would have been like to grow up with a father who did not go to work every day wearing a business suit the color of the wild blue yonder. I couldn't imagine it. I never had been able to.

The wings reminded me of Air Force Day airshows, of all the times I'd be fooling around out on the flightline with other Air Force brats, feeling superior to the awestruck civilians because we knew silver-winged secrets they didn't. When the first formation of jets would scream overhead we'd fall silent, the superiority knocked off our faces by the JP-4 burning far above, and watch in wonder as our dads rocketed across the firmament.

We knew what we were supposed to do. Nobody ever told us. We just knew. We were supposed to step into the cockpits when they got out. To go higher, faster, farther. It was just that simple.

But of course it was not that simple. The Vietnam War was everything but

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simple, for me and for every other serving son of the military. Long-suppressed memories erupted, memories of civilians shouting curses at me and my comrades. "Baby killers!" they yelled. "Napalm murderers!" Ignorant of our realities, most knew only what they saw on TV. But they hurt us. The images of my Air Force and the Air Force of my father clashed, mixed but did not mingle, and yet were bound together by the things that never changed: the traditions, the faith in each other, even the rituals of Reveille and Retreat and Taps. Always Taps.

"Hiya, Sport," he'd say when he got back from a mission, short blond hair smelling of Vitalis, flightsuit stained with sweat, kneeboard battered and chipped, helmet bag tossed into a corner. "Take the stick, Budro," he'd say in the Piper Cub as the little yellow plane climbed away from the sun-baked Kansas fields. "Too rough for ya?" he'd call over the Gosport tube in the Tiger Moth as he rolled and looped it, making the green and brown quilt of England wheel crazily.

Flying was life. But behind it, always, was Taps. Behind it, always, were Air Force fathers who took off and never returned. "Don't sweat it," my father would say when the base's flag was lowered to half-mast and one of my friends would leave school in a blue car. And then he'd add, ruffling my hair, "They knew what they were doing."

As did he. I read again the evidence in his decorations, the silver presentation mug from his last command. Is this all that's left? I wondered. And then the door to G102 opened. Dottie, Goodie, Helen, all of them came in, as they had always come into Air Force kitchens, arms full of food and hearts full of love, summoned by the swift, mysterious Word that moved even faster than the blue cars when an airplane was down and men had died. I didn't know them well but I knew them perfectly. They were the women who kept everything together on the ground when everything came apart in the air.

The memorial service was held in the Village Convocation Room. Chaplain Cooper reminded us of the eternal truths. It was easier for him because those who had gathered to remember my father had learned those truths long ago. A Marine colonel gripped my hand hard in the reception line. "I fought in three wars," he said, "and your father was the bravest man I ever saw." The colonel wasn't speaking of his heroism in combat, where young men act quickly, but of his heroism in cancer, where old men must act slowly. The man in G102 inspired them all, and they loved him for it.

When the memorial service was over, I surveyed the now-empty little apartment. There seemed to be no trace of him: a scratch on the wall paint, a burn on the kitchen linoleum. Was he ever there?

Overhead, a Boeing KC-135 dropped its landing gear and flaps to land at March Air Force Base, just across the freeway from me. I watched it for a moment, remembering the day the first gleaming KC-135 landed at our base in Idaho to replace the old prop-driven KC-97s. It was the day we decided the Jet Age had finally arrived. It was a day one era ended and another began. It was a day like any other day in the Air Force.

I slid closed the patio door to his apartment, started to walk away, and then stopped in his little patio, where he'd placed his hoya plants and hibachi. I knew something had not been done. I couldn't decide what it might be. Then I remembered.

I turned, stiffened to attention, and saluted the empty room. I held the salute a moment, not thinking, just being who I was: the boy who had become the man to bury the father. And a pilot, as he had been.

There was nobody in the room to return the salute, of course. But there had been. And as long as the place is called Air Force Village West, there will be again.

Happy landings, Dad. We're on your wing.

—Steven L. Thompson

DOUGLAS EDWARDS

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Exploring Western Religion and Art January 12-16 or February 2-6.

Introduction to Rare Books March 3-6.

Decorative Arts and Design March 19-22.

Civil War at Fredericksburg April 9-12.

Churchill (England) April 1-14.

Landscape Design May 3-7.

The New Astronomies (Tucson, Arizona) May 10-15 or May 17-22.

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The Cowboy and His Kites

Like Benjamin Franklin, Samuel F. Cody was lucky to survive his first great kite experiment. Around the turn of the century (no one knows the exact date), the expatriate American went out to a north London hillside, sat in a basket, and boldly launched himself into the air with a series of tiered kites. Things went well until he reached a height of 80 feet, when a gust of wind blew the whole contraption down into a stand of trees. Fortunately, Cody grabbed some branches, saving himself from a 50-foot fall. This dramatic aerial adventure was only one of many in a far-from-dull life.

Cody was born on March 6, 1861, in Birdville, Texas. As a young man, he was nearly killed when his family's ranch was attacked and burned by Indians. Around this time he became fascinated with Buffalo Bill Cody, the famous frontier scout and showman 15 years his senior, but no relative of Samuel's. The younger Cody, imitating his idol, grew long hair, a mustache, and a pointed goatee. When he was old enough he went to work as a cowboy; later, he shot buffalo to feed railroad crews, battled Indians, and even joined a Wild West show, gaining fame for his riding, sharpshooting, and rope twirling tricks. Cody especially enjoyed performing in England. On a visit there in the 1880s he met John Davis, who supplied horses to King Edward VII. Cody married Davis' daughter Lela and started a family.

Between 1894 and 1896 the Codys worked their way through Europe giving horsemanship and shooting exhibitions and racing horses against well-known cyclists of the day. In his book *Pioneer of the Air,* Cody's friend and biographer G.A. Broomfield wrote: "Another act with which he thrilled his audience was to station a lady in tights in front of an iron target and surround her with clay balls placed tightly around the outline of her body, after which he gaily proceeded to shoot all the clay balls to pieces.... The heroic lady in tights was his wife." Cody's penchant for showmanship eventually led to success as a theatrical producer and author of such cowboy plays as *The Klondyke Nugget, An Indian Bride,* and *Calamity Jane,* in which he, his wife, and their three sons played starring roles.

The family was living in England in May 1899 when Australian kite pioneer Lawrence Hargrave visited the country. Following Hargrave's tour, Cody bought a box kite for his young son Vivian and soon grew interested in perfecting giant man-lifting versions of his son's toy. Before long the American had improved on the designs of Baden Baden-Powell, an inventor who had designed manned observation kites for the Boer War in 1901. In Baden-Powell's version, the passenger, hoisted aloft by four box kites anchored by two widely separated cables, sat swaying uncomfortably in a small balloon basket slung between the cables. Because the dihedral wings of Cody's kites provided much greater stability, he needed only a single cable to carry the passenger.

Cody's man-lifting kites were large—up to 400 square feet with a 36-foot wingspan. Three of these giants provided the initial lift, then a fourth lifted a wicker chair that held the pilot, who could travel up and

LESLIE COBER

down the cable by using a locking pulley. Cody became a master at arranging kite-bracing wires to safely support loads, and in 1901 he was awarded British patent 23566 for his manned kite system. The patent included a wing warping technique much like the one used two years later by the Wright brothers. In a July 1903 article in *Pearson's Magazine*, Cody wrote, "I do not wish to assert that I have produced a flying machine in the full sense of the term, but I must confess that I have ambitions in that direction; and I hope at no very distant date to play an important part in the complete conquest of the air."

Before conquering the air, however, Cody decided to conquer the English Channel. That October he tried sailing from Dover, England, to France, accompanied by a newspaper reporter in a small canvas folding boat towed by several big kites. After struggling for some time with the winds and the tide, the two men finally gave up and rowed back to shore.

The following month Cody tried again, this time in the opposite direction, setting off alone from the French coast one evening. He made good time until the wind died and he was forced to lower his main kite. Then Cody lit a hurricane lamp mounted on the masthead and tried unsuccessfully to use his 15-foot kite as a sail. "After being nearly run down in the darkness by a large ship," wrote biographer Broomfield, "he drifted up and down the Channel all night with the tides until in the early dawn he was opposite his starting point. Soon after sunrise the wind freshened sufficiently for him to fly his kite, and using a sea anchor, or drogue, to give a bite to the pull he sailed serenely across the Channel and arrived at Dover in time for breakfast at 8.30 a.m. at his hotel." The entire journey had taken 13 hours.

Encouraged by this success, Cody continued to refine his kites. A 1905 article in Britain's *Aeronautical Journal* described the latest improvements: "[The pilot] has around him all the necessary steering gear, together with ascending and descending lines, and brakes for controlling the movements of the aeroplane during the upward and downward journey.... He has also with him a camera, a telescope, and a quick-shooting small arm, and is in constant telephonic communication with the winch controller whether on land or sea."

Cody knew that the British Navy was interested in using kites for submarine spotting and for transferring light objects from one ship to another. Supported by a recommendation from Baden-Powell, Cody pitched his kites to the admiralty, but the two parties were unable to agree on his compensation, so Cody ended up working for the British War Office, which ponied up £1,000 a year, plus fodder for his horse. Impressed by what they'd seen during the naval trials, the army named him chief kite instructor in April 1906.

Cody spent long hours testing his kites, often assisted by sons Leon and Vivian, who were civilian employees of the army. But it was now obvious that the Wrights' airplane was more than a passing fad, so Cody eagerly accepted a commission to design the steering surfaces and understructure of the first British airship, *Nulli Secundus I* ("Second To None I"), which was launched in September 1907.

During that winter, Cody, who had never seen an airplane, borrowed the airship's 50-horsepower Antoinette engine and built himself a biplane. He made a series of test flights in the spring—never getting very far off the ground—which the newspapers called "rolling experiments" and critics dismissed as "lawn-mowing." Success came a year later: on October 16, 1908, Cody flew his British Army Aeroplane No. 1 for 27 seconds, officially becoming the first man to fly an airplane in England. After traveling 1,390 feet the airplane crashed, but Cody emerged unscathed.

When the War Office let his contract expire in 1909, Cody continued to work as a private airplane designer and pilot, notable among his peers for his advancing years (he was nearly 50). Throughout his aeronautical endeavors Cody never relinquished the horse, six-guns, and cowboy dress of his show business background. It was this combination of aeronaut and showman that made Sam Cody the first aviation superstar and a crowd favorite at European air meets. Despite the flamboyant style, Cody remained a family man, fond of children and animals. There was never a shortage of women who wanted to ride along with him on his public flight demonstrations. But feeling that it was improper to sit so intimately, Cody never took any woman aloft save his wife.

His victories in airplane races and his other honors inspired him to plan a solo flight across the Atlantic. But before he could make his attempt, an airplane crash on August 7, 1913, took his life. More than 100,000 spectators lined the route of his funeral cortège. Even in death the one-time Texas cowboy managed once more to make history: he was the first civilian to be buried in the British military cemetery at Aldershot.

—Richard Sassaman

"Fastest Planes in the Sky," *episode of NOVA, PBS, November 12, 8 p.m. EST (check local listings).*

In 1909 Glenn Curtiss set the record for speed in the air at an international meet in Reims, France. He flew all of 47 mph, and in an age when airline passengers (albeit high-paying ones) can fly across the Atlantic at Mach 2 aboard the Concorde, that sounds like a small achievement indeed. But, to paraphrase a Chinese proverb, a journey at a thousand miles an hour begins with a single step.

NOVA's "Fastest Planes in the Sky" (reviewed here in a rough cut) is a careful if not tremendously exciting primer on aviation's never-ending quest for speed. During World War I the Fokker Dr.I Triplane's top speed was about 100 mph; by the end of the second world war, the German Me 262 jet fighter could reach Mach .86, or more than 540 mph. And today the SR-71 Blackbird holds the record for air breathers—somewhere around Mach 3, though the masters of the now-retired spy plane won't say for sure.

Speed is a good thing, for both military and civilian aircraft. Military airplanes, naturally, need to outpace their adversaries, and for commercial airplanes, time is money. But there are some caveats. While the Concorde reduces flight time considerably, it is also extremely expensive to fly. Its fuel cost per passenger is 16 times that of a Boeing 747, and over the years the airplane has been a notorious money loser.

The reasons for that lie in the complexities of supersonic flight; everything from sonic booms to the heating by air friction of an airplane's skin. All this and more is explained by the program's experts, which include *Air & Space/Smithsonian* contributor Richard P. Hallion and National Air and Space Museum curator R.E.G. Davies. Aided by some nifty wind tunnel photographs of shock wave formation, "Fastest Planes" does provide a good lesson on the dynamics of going really, really fast.

While the technical explanations can sometimes seem dutiful, the real joy is in the archival footage. It ranges from the seriously silly (New England birdman Willard Blaine leaps from a rock, wings strapped to his back, only to land flat on his face with a muffled "Ooh boy!") to the tragic (Lowell Bayles flies his Gee Bee racer to an unofficial speed record of 314 mph in 1931, only to die minutes later in a fiery crash).

In the course of an hour, "Fastest Planes" hits all the expected touchstones. You'll see Chuck Yeager flying the X-1, a sequence on the SR-71, and some prime X-15 footage, including one landing when the rocket plane broke in two. The pilot of that flight was Scott Crossfield, one of the program's more entertaining on-screen commentators. He recounts an engine ground test in which the X-15 exploded, blowing his cockpit section some 30 feet away. He recalls that after the explosions, he flippantly said to reporters, " 'The only casualty was the press in my trousers when the firemen wet me.' Then I winced when I realized what I had given the bastards. So sure enough, the next day an east coast newspaper had a headline: 'X-15 Blows Up; Pilot Wets Pants.' "

—Tom Huntington is the managing editor of Air & Space/Smithsonian.

The Dream is Alive: A Window Seat On the Space Shuttle *produced and directed by Graeme Ferguson for Imax Space Technology Inc. Distributed by Finley-Holiday Film Corporation (1-800-345-6707). 37 min., $29.95.*

Recently released on videocasette, the 1985 film *The Dream is Alive* inevitably loses much of its grandeur and drama away from the giant-screen IMAX theaters for which it was created. Its gorgeous images, however, still have the ability to dazzle.

Those Wonderful Women in Their Flying Machines: The Unknown Heroines of World War II *by Sally Van Wagenen Keil. Four Directions Press, 1991 (revised and expanded edition). 418 pp., b&w photos, $24.95 (hardbound).*

Despite the title of this book on the Women's Airforce Service Pilots of World War II, we WASPs didn't think we were wonderful at all. We were just a bunch of young women with a patriotic spirit and an unquenchable thirst for flying—not necessarily in that order. To us, what was truly wonderful was that we were being *paid* to fly aircraft that were bigger, sleeker, and faster than anything we had ever dreamed of.

Those Wonderful Women in Their Flying Machines meticulously traces Jacqueline Cochran's successful battle to persuade skeptical military powers to establish the WASP organization. But the book offers much more than that. The lively narrative conveys the intense singlemindedness and excitement of that time in the lives of the women pilots, who were performing numerous non-combat missions and ferrying to ports of departure every variety of Army Air Corps fighter, bomber, and cargo plane.

Avenger Field, on the outskirts of Sweetwater, Texas, looked like any other Army Air Corps flight training facility except for one small detail: all the cadets were women. They were recruited for the program because they were licensed pilots, but at Avenger Field they were taught to fly The Military Way, and they received the same primary, basic, and advanced training as male cadets. What young author Sally Van Wagenen Keil couldn't describe, because she wasn't there, was what a horrible sight we were in our man-size GI flight coveralls, our sleeves and pants legs rolled up as much as 12 inches to uncover our hands and feet and the whole droopy thing held together by a belt in the middle. Mercifully, after graduation we were issued snappy blue uniforms.

Keil, a gifted writer and a pilot, interviewed dozens of ex-WASPs, and her recounting of many of their experiences brings this history vibrantly alive. Keil puts the reader in the cockpit with Marion Hanrahan as she tows a target for male gunnery trainees to shoot at, and we feel and hear stray bullets ricochetting off her airplane. We share Nancy Betson's euphoria on her first flight in the huge and powerful Republic P-47 single-seat fighter. Reading on, I recalled my own assignments flying bombing missions over California's Mojave Desert while my

Those Wonderful Women In Their Flying Machines

Sally Van Wagenen Keil

load of male cadets took turns at the Norden bombsight in the airplane's glass nose, dropping our bombs on circle targets.

The first edition of *Those Wonderful Women in Their Flying Machines* was published in 1979; this revised and expanded edition includes more photos as well as a welcome account of how the WASPs, who had civilian status in World War II, were finally recognized in late 1977 as having been part of the military and were given veteran status with all its benefits. Also added is Jacqueline Cochran's fascinating 51-page *Final Report on Women Pilot Program,* which documents that the WASP's performance compared favorably with that of male military pilots carrying out similar duties.

—Peg (Wissler) Roberts, class of 43-W-6 at Avenger Field, writes books on California history and articles for childrens' magazines.

From Takeoff to Landing: Everything You Wanted to Know About Airplanes But Had No One to Ask *by Ed Sternstein and Todd Gold. Pocket Books, 1991. 240 pp., $7.95 (paperback).*

This nifty little book is a tranquilizer for white-knuckle fliers and a good education for those intrigued by but not steeped in aerodynamics, aircraft maintenance, and meteorology.

Author Sternstein knows whereof he speaks—he's been a Delta pilot for the last 12 of his 21 years of flying. Co-author Gold is a journalist and frequent flier who claims that in turbulence, he "has been known to pick up the in-flight telephone and dial 911." (The Henny Youngman humor is confined to the introduction.)

In a Q&A format, the authors use straightforward, no-jargon prose without stooping to condescension to explain in detail the rituals involved in an airline flight—all the stuff the passenger never sees. They start with airline dispatchers checking pilot reports and the route and speed of the capricious jet stream two hours before takeoff, and they finish with an explanation of why, after landing, your aircraft may have to cool its heels in the "penalty box," a concrete lounge used when no gates are available for arrivals.

You'll learn that because of food poisoning concerns, the captain and first officer cannot eat identical meals from the same kitchen (passengers, you're on your own), that the wings of a Boeing 747 are capable of flexing 29 feet up and down without damage (though I wouldn't want to be on one flapping that vigorously), and that the request to "PLEASE BE SEATED" prior to a timely pushback from the gate is sometimes terse because the captain can be fined by the Federal Aviation Administration for moving the aircraft while passengers are milling about in the aisle. And in the section on cabin pressure, you'll learn that "flight

attendants are trained in various helpful techniques [of clearing the ears during descent], such as squeezing your nostrils and blowing lightly." I don't know about you, but no flight attendant has ever offered to squeeze my nose.

At any rate, the book is packed with neat trivia as well as lucid explanations of aircraft systems and airline procedures. And it fits right in your carry-on bag.

—Patricia Trenner is the departments editor of Air & Space/Smithsonian.

Credits

"I Can't Control the Airplane." Alfred C. Haynes began working for United Airlines in 1956, eventually logging over 30,000 hours of flight time before retiring last August.

Parting the Water. Alex Heard is a Washington, D.C.-based writer.

Slim Lewis Slept Here. Donald Dale Jackson first visited Bellefonte, Pennsylvania, ten years ago to research *Flying the Mail,* one of seven works he has written for Time-Life Books. Like many Bellefonte residents, he never became a pilot, though he did ride shotgun when his friends buzzed the girls' dormitories at Stanford long ago.

Moving Day. Contributing editor Stephan Wilkinson, known as a "speedy little devil" by Poughkeepsie air traffic control, managed to get in some 50 hours of flying time in 747SW before a friend landed it on its belly when the landing gear jammed.

Fast Forward on Venus. Greg Freiherr is a contributing editor of *Air & Space/ Smithsonian.* Videotapes made in the JPL Digital Image Animation Laboratory can be purchased from Western World: The Video Tape Company, 10523-45 Burbank Blvd., North Hollywood, CA 91601.

Wings of the Great War. Jeffrey L. Ethell flies and writes about fighter aircraft and is the author of such books as *Target Berlin* (Sterling Publishing/Arms & Armour, 1988) and *One Day in a Long War* (Random House, 1990).

Fate Was the Hunter. Boeing 737 first officer Jerry Slocum has been a flight instructor, a Learjet pilot, and a contributor to aviation magazines.

Driven by the Wind. Peter Garrison is a freelance writer living in Los Angeles. His leisure activities include computer programming, building a four-seat airplane of his own design, and shuttling his children among various places of entertainment.

The Greatest Airports Never Built. Benjamin Forgey is the architecture critic of the *Washington Post.*

This Target Earth. A contributing editor of *Air & Space/Smithsonian,* Gerrit L. Verschuur wrote "Fax From the Moon" for the June/July 1991 issue.

A Single Daring Act. James Salter's most recent book, *Dusk and Other Stories,* won the PEN/Faulkner award for fiction in 1989. He is currently working on a memoir that will be published next year by Random House.

Taps for G102. Steven L. Thompson is a contributing editor of *Air & Space/ Smithsonian.*

The Cowboy and His Kites. This is Richard Sassaman's fourth appearance in *Air & Space/Smithsonian.* His three previous articles covered a sacred trinity: the Wright brothers, Charles Lindbergh, and the Bible.

Yankee Ingenuity. Phil Scott lives in Manhattan. Last year he exhibited a bit of Yankee ingenuity by living in Connecticut, which had no state income tax.

Calendar

October 4–6
American Aviation Historical Society Convention. Beverly Garland Hotel, Sacramento, CA, (415) 368-0817.

Copperstate Fly-In. Love Field, Prescott, AZ, (602) 298-3522.

October 5 & 6
Museum of Flying Auction. Warbirds, classic aircraft, and aviation memorabilia. Museum of Flying, Santa Monica Airport, CA, (213) 452-0999.

Quad-Chapter Fly-In. Sponsored by Experimental Aircraft Association. Forum on homebuilt propeller carving. Sussex Airport, Sussex, NJ, (201) 702-9719.

Superbatics 91 Airshow. Forbes Field, Topeka, KS, (913) 862-3303.

October 6
Fly-In Breakfast. Sponsored by Skyhaven Pilots Association. Skyhaven Airport, Tunkhannock, PA, (717) 836-4800.

October 12
Airline Collectibles Show and Sale. Sponsored by Bay Area Airline Historical Society. Grosvenor Airport Inn, South San Francisco, CA, (415) 574-8111.

Fly Market. Sponsored by Experimental Aircraft Association. Merchandise for sale includes new and used aircraft parts and aeronautical books, art, jewelry, and clothing. Franklin County Airport, Mt. Vernon, TX, (903) 856-5992.

October 12 & 13
Fort Worth Airshow. Alliance Airport, Fort Worth, TX, (817) 624-2727.

October 22 & 23
Conference on Earth Observations and Global Change. National Press Club, Washington, DC, (313) 994-1200.

November 1–3
Radio-Controlled Schneider Cup Re-enactment. Lake Havasu City, AZ, (602) 855-6900.

November 9
Aviation Art Show. Champlin Fighter Museum, Mesa, AZ, (602) 830-4541.

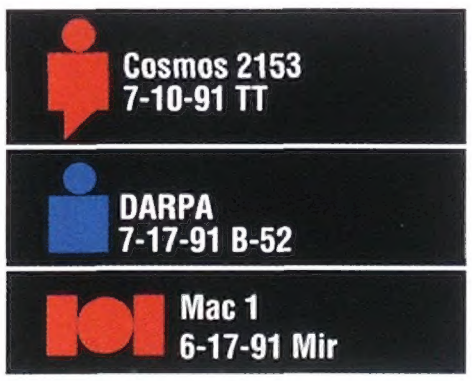
November 9 & 10
Thunderbird Invitational Balloon Classic and Airshow. Glendale Municipal Airport, Glendale, AZ, (602) 978-7208.

"The Satellite Sky" Update/26

These regular updates to "The Satellite Sky" chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.

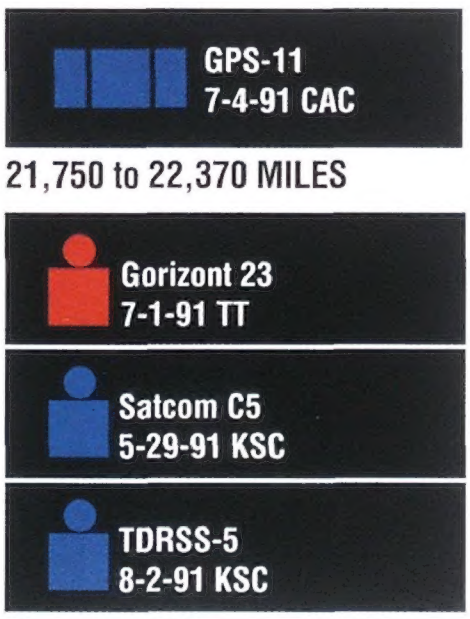
New launches

90 to 300 MILES



300 to 630 MILES

6,200 to 13,700 MILES



21,750 to 22,370 MILES

RCA Sat-3R

Deletions

90 to 300 MILES

Cosmos 2149
down 7-4-91

Resurs F-10
down 6-20-91

Inoperative but still in orbit

300 to 630 MILES

Cosmos 1908 Cosmos 1954 Geosat 1

21,750 to 22,370 MILES

RCA Sat-3R

Launched but not in orbit

90 to 300 MILES

Cosmos 2152 USSR earth sensors	7-9-91	down 7-23-91
Resurs F-11 USSR earth sensors	6-28-91	down 7-21-91
Resurs F-12 USSR earth sensors	7-23-91	down 8-8-91
STS-43 U.S. research	8-2-91	down 8-11-91

DATA: SAUNDERS KRAMER

Forecast

In the Wings...

Megamodels. If you think model airplanes are small, you've never been to the Rally of the Giants.

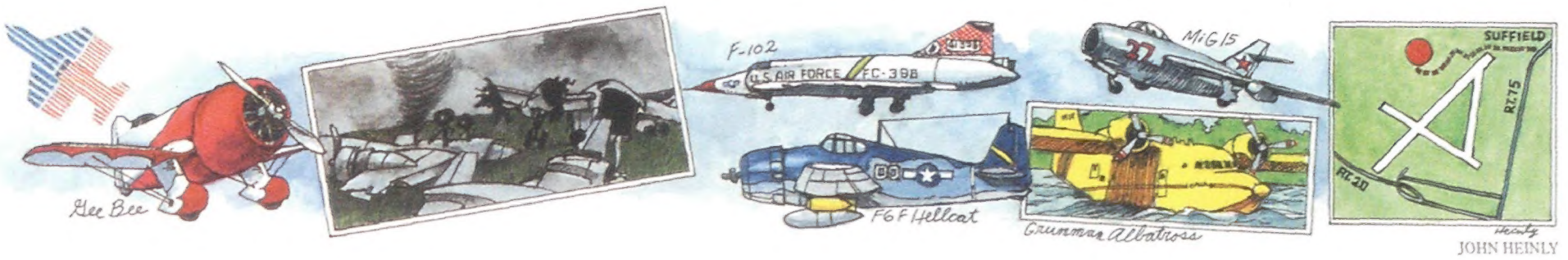
Flow Control. Why your ground delay in Chicago may have resulted from a decision made in Washington, D.C.

Moonbase. The moon may be a nice place to visit, but why would anyone want to live there?

Should We Have Saved Skylab? As the future of a U.S. space station remains in doubt, thoughts turn to the past—and the space station we already had.

The Air War on Drugs. The United States is showing Bolivia how to combat cocaine processing on the ground by taking to the air.

Biosphere II. Is its science valid or not? Run by profiteers or visionaries? One thing is certain: no other experiment is quite like it.



JOHN HEINLY

Yankee Ingenuity

On a drizzly December afternoon, Kim Jones tramps across wet landfill gravel in the New England Air Museum's tornado alley. Brushing aside weeds, he points to another exhibit. "The tornado blew that F-102 onto Route 75," says Jones, vice president of the NEAM. "The National Guard was told to clear the highway, so when they pushed it aside with a bulldozer they tore the aircraft's nose off. If we had known when they were going to do it we could have helped them move it properly. But they were only following orders."

Various Vietnam-era U.S. fighters flank the F-102, wings twisted or crushed, with an occasional collapsed nosewheel or main gear. These are the lucky ones.

The funnel cloud touched down at Windsor Locks, Connecticut, at 2:56 p.m. on October 3, 1979, and sliced through the museum's outdoor display. In four minutes nature accomplished what various wars failed to do, destroying 23 aircraft, including a Douglas C-54 and C-133, a Fairchild C-119, and a Lockheed Constellation. Nearly 40 others were damaged.

"The most severely damaged airplanes were the big ones," says Jones. "All of them were irreplaceable. The Constellation was picked up, thrown a thousand feet, and landed upside down. Our Grumman Albatross was lifted over two other airplanes and slammed into the side of a rare B-17G. You can still see where it hit on the B-17's tail section over there."

The twister also sucked the roof off the museum's hangar, rendering the building a total loss and damaging exhibits inside, including a 1911 Blériot. Twelve years after the storm, says Jones, people still think the tornado permanently closed the museum. But staffers began cleaning up as night fell, and within a month the museum reopened its outdoor exhibit area with the least damaged aircraft. On the second anniversary of the tornado the NEAM dedicated a new exhibition building.

The first aircraft you see upon entering that building is a Piper Cub, which brings to mind a roadside zoo with a house cat on exhibit. But close by rest the Laird Solution, which won the 1930 Thompson Trophy, and the 1934 Marcoux-Bromberg Special, a perennial winner of second place during the golden age of air racing. Between a barrel-chested Republic P-47D and an F-105 sits the NEAM's latest acquisition, a MiG-15. "This was one of the best airplanes built," says Jones, who helped reassemble it. "The party we bought it from sent along the instruction manual, but it was useless—it was in Chinese."

Hellcat aficionado Larry Webster is resurrecting a Grumman F6F from the corpse of a former drone, one of several the Navy converted to test the accuracy of its early heat-seeking missiles. "Each was given a woman's name," says Webster. "This one was called Mary—presumably a pilot in the unit held a grudge against someone by that name. There were flares mounted on each wing, which would fire to simulate the heat of jet exhaust and thus attract the missile, and a bomb inside the aircraft that could be exploded remotely."

In 1956 Mary got lucky and crashed before being blown to smithereens. Navy personnel stored the Hellcat upside down, stripped it for parts, and chopped holes in the fuselage for impromptu storage space. When the Navy permanently loaned what was left of Mary to the museum in 1973, Webster began spending his spare time restoring it. "I'd like to get her done by this summer," he says, a statement that elicits snickers from nearby NEAM members. "Well, come back in a year," he says, putting a corroded hose fitting back in a box that contains a turret he's collected for his next restoration, a Grumman TBM Avenger.

Robert North keeps a photo album of his project, the Gee Bee R-1 Super Sportster. Though not a restoration (the R-1 in which Jimmy Doolittle won the 1932 Thompson Trophy Race later crashed), some say it's a step above an exact replica because designer Pete Miller, 88, the last surviving member of the team that produced the stubby, volatile racer, occasionally stops by to offer advice.

Good thing he does, for not everything is on the plans the Granville brothers donated to the museum "under the condition that when we built the replica, nobody, but *nobody,* be allowed to fly the finished product," North says.

"I asked Pete for details on the position of the controls," he says. "He said, 'Bob, we fit those controls to Jimmy. You're a little guy like him and you're a pilot—you know where they should be. So you crawl in there and they'll be within an eighth of an inch of where they should be.'

"The foot pedals—exact replicas—those were reproduced by a Maryland guy who makes parts for off-road racing vehicles," says North. "He volunteered to make the pedals because his mother was a secretary to Zantford Granville and his father worked for the brothers as a mechanic."

All these connections to the Granville brothers are not sheer coincidence; the Gee Bee factory used to be right up the road in Springfield, Massachusetts. Also highlighted are contributions to American aviation from New Englanders Sikorsky, Pratt & Whitney, Kaman, and Hamilton Standard. The NEAM boasts one of the largest aircraft and engine collections in the United States.

"We had as many as 150 aircraft at one time," says Jones. "We're now trying to trade some to someone who can take care of them and put them inside. That's a Loon missile, an American copy of a German V-1. Over there I've got a couple of Junkers Jumo engines from an Me-262. We store what we can inside, hope the seals stay tight on those engine cans, cover what we can of the rest with tarps."

—Phil Scott

New England Air Museum, Bradley International Airport, Windsor Locks, Connecticut. Phone (203) 623-3305. Open daily 10 a.m. to 5 p.m. Admission $5.50; discounts for seniors and children.

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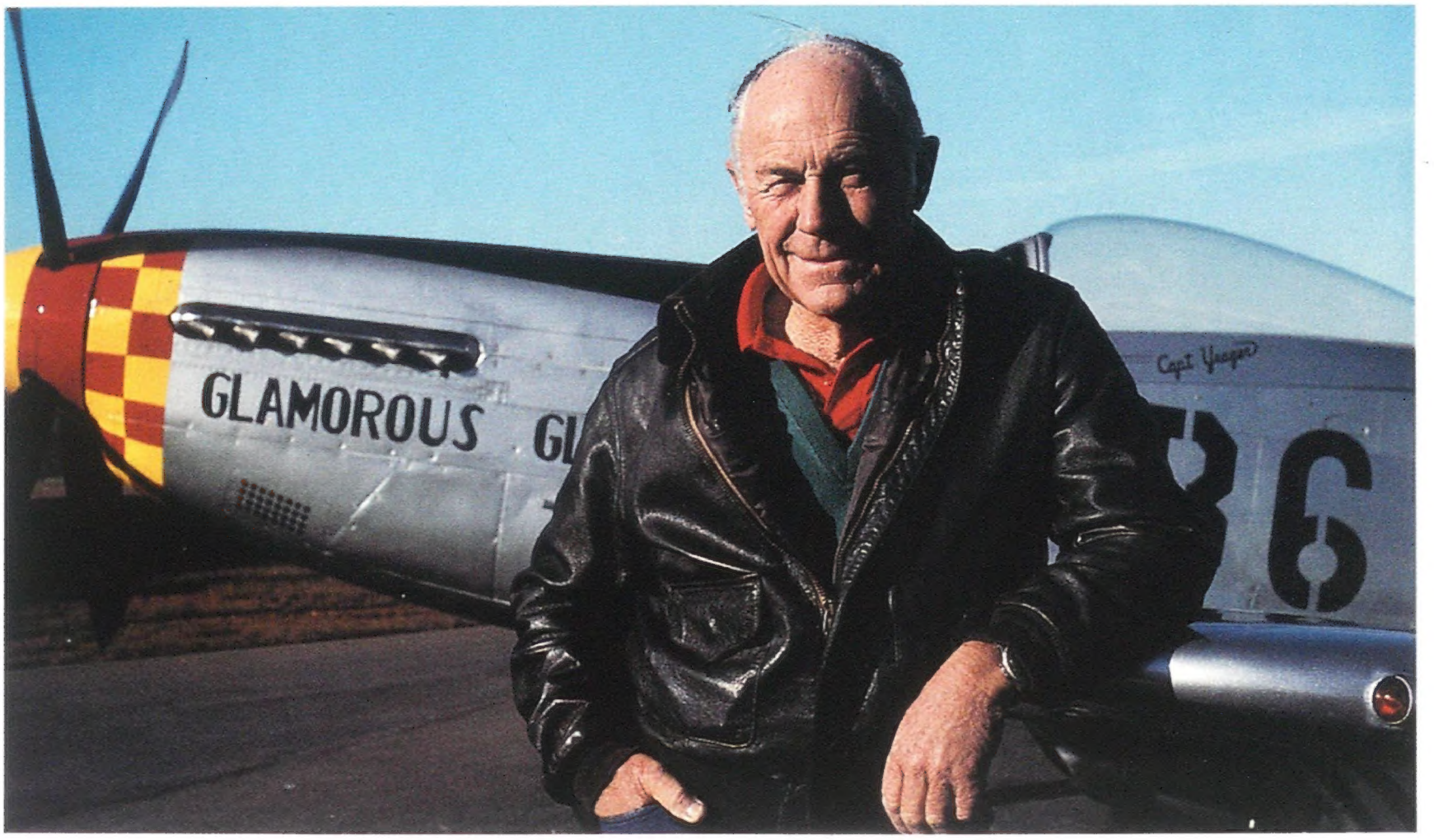
The moral being: Set out to build a conventional car, and it will come out looking ordinary.

Set out to build a complete car – one that doesn't compromise one virtue for another – and you'll end up with a Saab. Which is admittedly different. And demonstrably better. A point best demonstrated by seeing your Saab dealer for a test drive.

SAAB

WE DON'T MAKE COMPROMISES. WE MAKE SAABS.™

*The Saab 900 4-door sedan based on 1990 HLDI study. **MSRP, excluding taxes, license, freight, dealer charges and options. Prices subject to change.



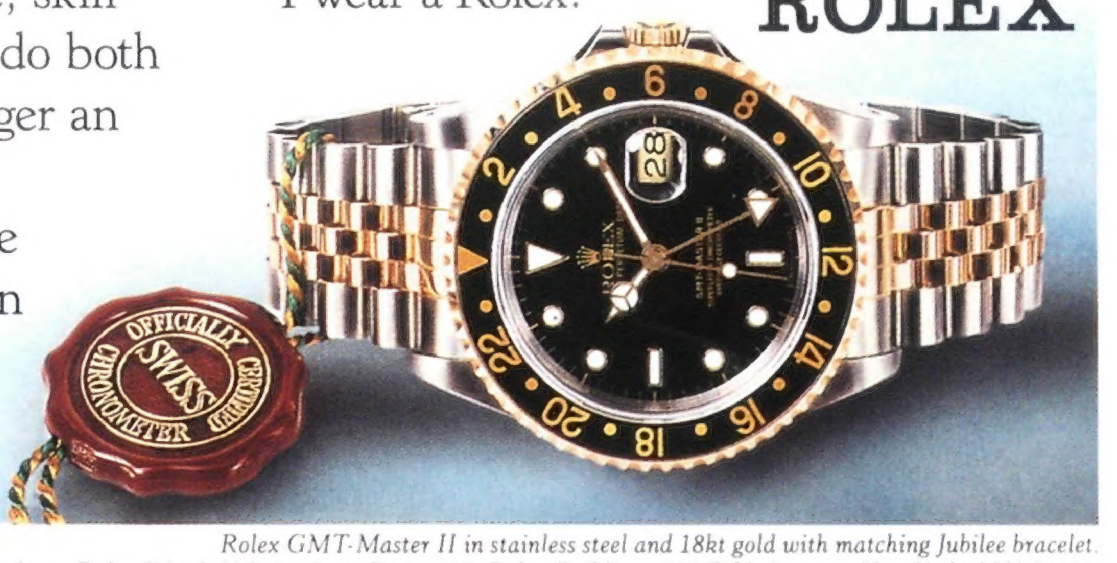
"If you want to grow old as a pilot, you've got to know when to push it, and when to back off." *Chuck Yeager*

Throughout his remarkable career, Chuck Yeager has shown an uncanny talent for what pilots call "pushing the edge of the envelope." At 21, only three years after boarding his first plane, Yeager was leading a squadron of fighter pilots in World War II. And at the age of 24, he became the first person to fly faster than the speed of sound.

Attempting such dangerous feats is one thing. Living to describe them to your grandchildren is another. Displaying the enormous courage, skill and cool judgment needed to do both has made General Chuck Yeager an authentic American hero.

Although retired from the military, Yeager remains a man on the move. He's an avid sportsman with a lifelong love of the outdoors, a lecturer and a consulting test pilot who still loves to fly. "Maybe I don't jump off 15-foot fences anymore," said Yeager, "but I can still pull 8 or 9 G's in a high-performance aircraft." And in all his exploits, Yeager depends on a rugged and reliable timepiece. "I wore a Rolex 40 years ago when I broke the sound barrier and I still do today," says Yeager matter-of-factly. "A pilot has to believe in his equipment. That's why I wear a Rolex."

ROLEX



Rolex GMT-Master II in stainless steel and 18kt gold with matching Jubilee bracelet.
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